SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY, 1929.

GENERAL PHYSICS.

1. Displacement Interferometry of Barometric Pressure. C. Barus. *Nat. Acad. Sci., Proc.* 14. *pp.* 641–645, *Aug.*, 1928.

Shows that it is difficult to use the interferometer U-gauge as a microbarometer since it acts also as a very sensitive air thermometer. This has been made clear by observations over periods of about nine hours and comparing the curves obtained with those obtained with a barometer and a thermometer giving the temperature of the observation room. Measurements made during small time intervals taking readings with the support of the instrument tilted through different angles and back again indicated that surface viscosity influences the readings. H. N. A.

2. Free-Fall Apparatus for Newton's Second Law of Motion. P. L. Tea. *J.O.S A. and R.S.I.* 17. *pp.* 138–144, *Aug.*, 1928.

A new apparatus is described for obtaining an accurate table of time and distance of a freely falling body. By the use of counterweights, the device serves as an accurate Atwood's machine to verify Newton's Second Law of Motion. The apparatus is simple and is claimed to be specially suitable for beginners in physics. The zero point is determined accurately, and tests can be duplicated to 0·001 sec. for each point. L. L. B.

3. Wireless Direction of Coincidence Apparatus for Relative Gravity Measurements. E. Berger. *Zeits. f. Instrumentenk.* 48. *pp.* 366–374, *Aug.*, 1928.

Attention is directed to the disadvantages of the v. Sterneck method of relative gravity measurements, and a method is developed involving the use of wireless time signals. The closing of a contact by the oscillation of a pendulum affects the grid of a valve in such a manner as to make it radiate momentarily. The duration of the impulse must not fall below a certain minimum value, as the oscillation takes a certain time to build up, and in the reception of the signal a duration of a few tenths of a second is desirable on practical grounds. Only the beginning of the impulse is utilised. The measurements may be made with an accuracy of some hundredths of a second. L. L. B.

4. Model to Illustrate the Operation of the Foucault Pendulum. F. E. Wright and F. H. Schloer. *J.O.S.A. and R.S.I.* 17. *pp.* 119–126, *Aug.*, 1928.

A model has been made showing in a mechanical way how the Foucault pendulum, set up at any latitude in the Northern hemisphere, rotates at a definite speed, varying inversely with the sine of the latitude, relative to that of the globe turning in the opposite direction. The model facilitates the explanation of the principle on which the Foucault pendulum is based. It consists of an electrically-driven 8-in. globe, representing the rotating earth, and a small triangular piece, which can be set at any latitude, representing the Foucault pendulum and the plane in which it swings. This is driven at the proper relative speed, inversely proportional to the sine of the latitude, by means of a friction wheel pressing against a centrally-fixed hemispherical cam of the same diameter. L. L. B.

5. Damping for Gyro-Compasses. K. Glitscher. *Phys. Zeits.* 29. *pp.* 566–570, *Aug.* 15, 1928.

Criticises Martienssen's explanation [see Abstract 2031 (1928)]. Mainly mathematical. W. G. B.

6. Oscillation Period of an Unpoised Balance Wheel. H. Bock. *Zeits. f. Instrumentenk.* 48. *pp.* 413–416, *Sept.*, 1928.

It has long been known to the practical watchmaker that the degree to which a clock goes " fast " or " slow " depends upon the amplitude of the oscillations of the unpoised balance wheel. This is proved to be mathematically correct. It is shown that with increase of amplitude the degree to which the clock is fast decreases to zero at 222°. With further increase of amplitude the clock goes " slow," but ultimately a second zero point is reached. L. L. B.

7. Simple High-Speed Rotary Pump. L. E. Bayliss, E. A. Müller. *Journ. Sci. Instruments,* 5. *pp.* 278–279, *Sept.*, 1928.

A small rotary pump is described, suitable for liquids or gases, in which the fluid is forced through a rubber tube by the pressure of a series of rollers passing along it. AUTHORS.

8. Magnetically-Operated Circulating Pump for Gases. F. Adcock. *Journ. Sci. Instruments,* 5. *pp.* 290–292, *Sept.*, 1928.

A description is given of a simple form of gas circulating pump designed so as to avoid risk of contaminating the gas with either oil or air. Motion is imparted to an iron piston by supplying an interrupted current to a solenoid which surrounds the upper part of the pump barrel. The pump has been used for circulating hydrogen at rates up to 30 cubic feet per hour. AUTHOR.

9. Consistent System of Units for Use in Teaching Physics. H. Hermann. *Phys. Zeits.* 29. *pp.* 623–625, *Sept.* 1, 1928.

A consistent set of units covering all branches of physics would be a great convenience. The practical system of electrical units would form a starting-point for this, but on examination the fundamental units turn out to be 10^7 metres, 10^{-11} gramme, and 1 second—which are hardly suitable for ordinary mechanics. Some other possibilities are also discussed, but they all fail in some similar way.. W. G. B.

10. Relations between the Symmetry of Physical Phenomena and their Representation by Means of Vectors or of Tensors. A. Liénard. *Ann. de Physique,* 10. *pp.* 5–69, *July–Aug.*, 1928.

It sometimes happens that a method of representing a phenomenon, which leads to simple calculations, does not correspond as closely to physical reality as another method, in which the calculations are more difficult. The object of the paper is to show the advantage of using both the methods in question, each of which has its advantages. To every symmetrical left-handed tensor T, of order p, corresponds another symmetrical left-handed tensor T′, of order $(n - p)$, where n is the number of the dimensions of the space. There is complete reciprocity between T and T′, and a knowledge of one of them includes that of the other, except as to its sign. One of these tensors gives a perfectly adequate representation of the phenomenon, but the other may be more convenient to use; T′ is said to be the conjugate tensor of T. The second chapter deals with polar and axial vectors; phenomena which can be represented by axial vectors can be better represented by the conjugate tensor of the second order of the vector. The results obtained are applied to electromagnetism; it is shown that the analogies between an electric and a magnetic field are purely of a mathematical nature, the physical analogy, which some physicists have supposed to exist, is non-existent. Volumes, lengths and surfaces must be treated either as scalars or as left-handed symmetrical tensors of various orders, according to circumstances. The definition of elastic tensions and the determinations of fluxes and of the integrals of lines are dealt with by the author's method. H. N. A.

11. Photoelasticimetry. Theory, Methods and Applications. G. Delanghe. *Rev. d'Optique,* 7. *pp.* 237–265, *June–July, and pp.* 285–313, *Aug.,* 1928.

In the first paper the experimental method known as photoelasticimetry is described, this having been designed to avoid the laborious application of the mathematical theory of elasticity. The method depends on the construction of a transparent model of the sample to be constrained and the examination by optical means of the birefringence acquired through the elastic strain produced by the impressed forces. The strains are then deduced in the actual specimen. The generality of the method for various branches of engineering, such as mechanical and metallic constructions, aeronautics, etc., is emphasised. The second paper is devoted to applications of the method and includes the experimental verification of the hypotheses assumed in the theory of the resistance of materials, a bridge study, a discussion of Coker's apparatus for the application of loads to bridge models, the study of a wall with concrete foundation, a cantilever beam, the distribution of internal stress in a breaking test piece, the influence of notches, holes (circular and elliptical) and cracks on the distribution of internal stress, the distribution of pressure at the contact of an axle, bolt or rivet with the plate it traverses, application of photoelasticity to the working of machines, the tension of a cable, the determination of the elastic constraints in brake-wheels, and the study of the action of cutting tools. The paper contains 62 diagrams. H. H. Ho.

12. Diffraction of Elastic Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 5. *pp.* 59–70, *Aug.,* 1928. *In English.*

The problem of two-dimensional elastic waves passing through a slit in a screen is solved in terms of the Mathieu functions. W. G. B.

13. Diffusion of Tremors on the Surface of a Semi-Infinite Solid Body. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 5. *pp.* 71–83, *Aug.,* 1928. *In English.*

The decay of certain displacement and velocity distributions near the surface of a visco-elastic solid is mathematically obtained. W. G. B.

14. Rayleigh-Type Waves Propagated along an Inner Stratum of a Body. K. Sezawa and G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 5. *pp.* 85–91, *Aug.*, 1928. *In English.*

The mathematical solution is obtained. W. G. B.

15. Propagation of Rayleigh Waves having a Certain Azimuthal Distribution of Displacements. K. Sezawa. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 267–270, *June*, 1928. *In English.*

The problem of the transmission of Rayleigh waves, having a certain azimuthal distribution of displacements, from a point in the surface of a semi-infinite solid, is somewhat similar to a problem treated by K. Terazawa, dealing with the elastic equilibrium of a semi-infinite solid, under a normal boundary pressure distributed unsymmetrically about a point in the surface. The method of analysis adopted is, however, different. It is shown that the velocity of propagation is the same as that of ordinary Rayleigh waves, though the azimuthal distribution of displacements is not uniform. In spite of the fact that the natures of the vertical and the horizontal components of displacement in wave profile and in azimuthal distribution are maintained, the azimuthal component of the displacement component disappears quickly as the distance from the origin increases. H. N. A.

16. Demonstration of Various Methods of Measuring Poisson's Ratio. J. P. Andrews. *Phys. Soc., Proc.* 40. *pp.* 340–341, *Aug.*, 1928.

Close copies were demonstrated of actual experimental arrangements previously used in researches on Poisson's ratio by the method of bending. W. S. S.

17. Application of Accidental Double Refraction to the Study of Stress Distribution in certain Selected Bodies. M. Wächtler. *Phys. Zeits.* 29. *pp.* 497–534, *Aug.* 1, 1928.

This comprehensive paper commences with a discussion of the fundamental phenomena of accidental double refraction produced in isotropic bodies and considers methods for its observation and measurement. A section is then devoted to the use of accidental double refraction for testing the homogeneity of transparent materials. Then follows its application to the evaluation of the state of stress and strain in a mechanical model, in which the fundamentals of the methods adopted are considered in detail with examples of simple cases of loading. A special technical case of the stress in cog wheels concludes the paper. No fewer than 102 literature references are included. H. H. Ho.

18. Stress-Strain Curves for Plastic Sulphur and Raw Rubber at Various Temperatures. J. D. Strong. *J. Phys. Chem.* 32. *pp.* 1225–1230, *Aug.*, 1928.

The object of this research is to establish the similarity of the elastic properties of raw rubber and plastic sulphur by the determination of elastic strain curves for each substance at various temperatures. It is suggested to call these substances "plastic-elastic" substances, because they are neither purely elastic substances like quartz nor pure plastics like clay. The stress-strain data were recorded automatically making possible a greater speed of testing, and it is for this reason that it is believed that the data are fairly independent of plastic flow. J. K.

19. Behaviour of Thick-Walled Cylinders under High Pressures. A. Michels. *K. Akad. Amsterdam, Proc.* 31. 6. *pp.* 552–559, 1928.

A note on the stresses in the walls of thick cylinders under high pressures. The paper is based on the fact that after compression, tension, or shear, in which the yield point has been passed, metals show an alteration in physical properties, and their strength is found to have increased. It is shown that in the case of a cylinder under high pressure the strengthening probably decreases in extent towards the outside of the cylinder. The most satisfactory material for obtaining high pressures must be such that the strengthening is as large, and can work as far, as possible through the material. The best material for high-pressure construction is such as indicated by the distribution of forces outlined in the paper. The results are confirmed theoretically and experimentally. S. G. B.

20. Impact of Two Bodies. J. Ôkubo and M. Hara. *Tohoku Univ., Sci. Reports*, 17. *pp.* 1011–1025, *Sept.*, 1928. *In English.*

By using a specially designed apparatus, the phenomena of impact of two bodies during the period of impact were studied experimentally. The materials tested were tin, aluminium, lead, zinc, copper, brass, soft iron, phosphor-bronze and india-rubber. The coefficient of restitution and the time of the three phases of the impact were determined as a function of the impinging velocity. It was confirmed that the volume of the indentation is proportional to the total loss of the kinetic energy of the impinging body, and that the resisting force which acts on the impinging body is proportional to the sectional areas on the surface of the specimen at the instant of the indentation. AUTHORS.

21. Free Path of Molecule and Coefficient of Internal Friction in Fluids. N. Gerasimov. *Phys. Zeits.* 29. *pp.* 575–584, *Aug.* 15, 1928.

It is shown by purely mathematical reasoning that the propagation of the movement itself is $\frac{v}{v-b}$ times the velocity of propagation of the material itself in a gaseous medium, and that the wave-length of the motion or movement bears a similar ratio to the wave-length of the material. An expression is deduced for the internal friction and is given by the formula:

$$\eta = k \cdot \frac{v}{v-b} \cdot \mathrm{T}^{\frac{1}{2}}.$$

This is calculated for CO_2 and compared with the experimental values of Phillips, with which it is in good agreement. The diameter of a molecule and the Avogadro number are deduced subsequently, and the whole subject of the title is discussed. S. G. B.

22. Internal Friction in Metals. R. H. Canfield. *Phys. Rev.* 32. *pp.* 520–530, *Sept.*, 1928.

A tubular specimen of the metal is made the elastic control of a heavy pendulum bar. The system can be set into forced vibrations, either bending or twisting the specimen, by a measured periodic magnetic force-couple. The resonance amplitude and frequency, with the moment of the impressed force-couple, yield the ratio of the energy dissipated in one cycle to the energy of the vibration. The tubular form of the specimen enables the relation between dissipation and stress-amplitude to be studied in detail, at least for torsion. For normal (unfatigued) metal, the internal friction appears to be entirely associated with shear. This is not borne out in certain specimens of fatigued or overstrained metal; but these exceptions are easily accounted for. If the energy dissipated per c.c. per cycle of stress-amplitude is represented by F, the relation of friction to stress-amplitude is given by the formula $F = 8\phi W(1 - f_0/f)$, where W is the total strain energy, ϕ is the coefficient of internal friction, and f_0 is a "threshold" stress-level which is zero initially, but takes on larger values as the vibration history becomes longer. If $f_0 = 0$, this formula is the same as that proposed by Kimball, *viz.*, $F = \xi f^2$. The coefficient ϕ here introduced is independent of the systems of units and to a certain extent independent of the vibration history. If f is less than f_0 the dissipation is negligible; if f is greater than another much higher level f_1, F increases faster than any power of f. Repeated cycles of high amplitudes cause all the constants gradually to change; f_0 decreases again, ϕ increases many fold, the upper limit itself may change. These progressive changes are probably associated with the progress of fatigue. AUTHOR.

23. Experimental Investigation of Forced Vibrations. L. W. Blau. *Frank. Inst., J.* 206. *pp.* 355–378, *Sept.*, 1928.

The solution of the differential equation $\ddot{y} + 2R\dot{y} + n^2y = E\cos pt$, where y = displacement from the position of rest, R = damping factor, $\frac{n}{2\pi}$ = natural frequency of the vibrating system, and $\frac{p}{2\pi}$ = frequency of the impressed force, is written in a new form which clearly exhibits many important facts thus far overlooked by theoretical and experimental investigators. Writing $s = n - p$, and $\Delta n = n - \sqrt{n^2 - R^2}$, it is found: (*a*) When $s \neq \Delta n$, there are "beats," and the first "beat" maximum is greater than any later maximum, while the first "beat" minimum is less than any later "beat" minimum. The "beat" frequency is $(s - \Delta n)/2\pi$. (*b*) When $n^2 - p^2 = R^2$, there are no "beats," and the resultant amplitude grows monotonically from zero to the amplitude of the forced vibration. (*c*) At resonance, when $n = p$, we still have maxima which occur with a frequency $\Delta n/2\pi$ in a damped system. (*d*) The absence of "beats" is neither a sufficient nor a necessary condition for resonance in a damped system.

In the experimental investigation the upper extremity of a simple pendulum was moved in simple harmonic motion and photographic records obtained of the motion of the pendulum bob. Different degrees of damping were used, ranging from very small to critical. The experimental results are in excellent agreement with theory. **Errata,** *ibid.*, p. 502, Oct., 1928. AUTHOR.

24. Mathematical Theory of the Statistical Methods Employed in the Study of Correlation in the Case of Three Variables. A. A. Tschuprow, L. Isserlis. *Cambridge Phil. Soc., Trans.* 23. *pp.* 337–382, *Aug.*, 1928.

25. Series of Bessel Functions connected with the Lattice-Points of an *n*-Dimensional Ellipsoid. J. R. Wilton. *Roy. Soc., Proc.* 120. *pp.* 358–369, *Sept.* 1, 1928.

26. Energy of a Body moving in an Infinite Fluid, with an Application to Airships. G. I. Taylor. *Roy. Soc., Proc.* 120. *pp.* 13–21, *Aug.* 1, 1928.

27. Forces on a Body placed in a Curved or Converging Stream of Fluid. G. I. Taylor. *Roy. Soc., Proc.* 120. *pp.* 260–283, *Sept.* 1, 1928.

The knowledge of the forces on a body in a converging stream of fluid is of importance in reducing wind-tunnel observations, as the flow in the centre of the channel is of this type, due to the retarding action of the walls. In this paper the effect of convergence and curvature of the undisturbed stream-line is found and correlated with various types of symmetry and asymmetry of the body. Experiments which verified the predictions of theory are described. W. G. B.

28. Experimental Study of the Fall of Spheres and Plates in Viscous Fluids. J. Schmiedel. *Phys. Zeits.* 29. *pp.* 593–610, *Sept.* 1, 1928.

The resistance to the motion of spheres (steel or aluminium balls) was obtained by allowing them to fall down the axis of a tube filled with the liquid (water-glycerine mixtures), allowance being made for the influence of the walls. Oseen's formula was in good agreement with the results—better than Stokes'. The resistance to thin circular discs (aluminium, silver and gold) was also measured. For Reynolds' numbers >80, the motion showed regular periodic sideways oscillations; the formation of a trail of vortices had set in, as photographs show. In the case of spheres, the vortices do not appear for Reynolds numbers <1000. W. G. B.

29. Adhesives and Adhesion: Pure Chemical Substances as Adhesives. J. W. McBain and W. B. Lee. *J. Phys. Chem.* 32. *pp.* 1178–1184, *Aug.*, 1928.

A previous paper [see Abstract 1615 (1927)] showed that pure chemical compounds may fully rival well-known adhesives for joining polished metal surfaces. The present paper extends these results to other pure compounds, and includes five highly purified carbinols, which had been used by Hardy and Miss Doubleday in experiments in lubrication. The adhesive strength is shown to vary in definite relation to chemical constitution. In the carbinol series density, static friction, and joint strength are at a maximum in the middle of the series. There is a notable increase of strength when the film of adhesive is made exceedingly thin, this being ascribed to chains of oriented molecules extending from the surfaces well into the liquid or solidified adhesive. The question of wooden joints is considered, and pure coumarin is shown to give a strong joint in which both specific adhesion and mechanical embedding are operative. T. B.

30. Variation of the Capillary Action of Solutions with Time. H. M. Trimble. *J. Phys. Chem.* 32. *pp.* 1211–1224, *Aug.*, 1928.

Reference is made to the work of Washburn and Bigelow [see Abstract 1453 (1928)], wherein it is shown that the surface tensions of certain aqueous solutions, as measured by the capillary rise method, vary with time and that where they used solutes which are more volatile than water the increase in this property was marked. The present author confirms the conclusion come to by these authors, namely, that the variation of the surface tension of a mixture of liquids with time is due to preferential evaporation of the more volatile substance. The rate and magnitude of the changes depend upon the size and length of the capillary tube, which, if kept constant, a knowledge of the surface tensions, volatilities and densities of the components of the mixture allow the nature of the change to be roughly predicted. It is again shown that evaporation must be completely prevented if trustworthy data upon the surface tensions of mixtures are to be obtained. J. K.

31. Surface Tension of Liquid Metals. Part III. Mercury. L. L. Bircumshaw. *Phil. Mag.* 6. *pp.* 510–525, *Sept.*, 1928.

The surface tension of mercury was measured by the method of maximum bubble pressure under a number of different conditions which yield values varying from 544 to 475 dynes per cm. These are discussed along with the results of other observers. [See also Abstracts 12 and 2659 (1927).] G. E. A.

32. Crystal Structure of Electrodeposited Chromium. F. Sillers, Jr. *Am. Electrochem. Soc., Trans.* 52. *pp.* 301–307; *Disc.*, 307–308, 1927.

X-ray crystal analyses, by the powder method, of electro-deposited chromium in both the " bright " and the " grey " or " burnt " conditions show that it has the body-centred cubic structure, the same as chromium obtained by ordinary fusion methods. No indications were obtained of a second or allotropic form of chromium, such as has been reported, and which, if present, might limit the applicability of chromium plate. The lattice parameter of electrolytic chromium is in agreement with precise measurements previously reported for ordinary chromium. AUTHOR.

33. Crystal Structure of Topaz. L. Pauling. *Nat. Acad. Sci., Proc.* 14. *pp.* 603–606, *Aug.*, 1928.

Leonhardt found the space group for topaz to be V_h^{16}. The author has made use of the coordination theory of ionic crystals to deduce a structure which agrees satisfactorily with Leonhardt's experimental results and belongs to the above space group. The fundamental polyhedra were assumed to be an octahedron of anions (oxygen and fluorine) about each aluminium ion and a tetrahedron of oxygen ions about each silicon ion, the length of a polyhedron edge was taken as 2·72 Å. The way in which these polyhedra are assumed to be connected and piled together is shown in a figure, which gives the arrangement of four different superposed layers. The dimensions of the unit of structure differ a little from those of Leonhardt if it is assumed that the octahedra and tetrahedra are regular. The unit contains $4Al_2SiO_4F_2$. The structure leads to reflection intensities which agree with the observations. The atomic positions and parameter values are defined in a table. H. N. A.

34. Crystal Structures of the Alkaline Earth Metals. G. L. Clark, A. J. King and J. F. Hyde. *Nat. Acad. Sci., Proc.* 14. *pp.* 617–618, *Aug.*, 1928.

Hull's results for calcium were fully substantiated both as to type of lattice and lattice constant. Barium was found to crystallise in the cubic system, with two atoms in the unit cell, constant 5·04 Å.; intensities indicate a body-centred lattice, density 3·52, agreeing with the value 3·5 given in the International Critical Tables, density measured with a very pure barium wire 3·64. Sharp spectra were not obtained with pure strontium, the films showing at the most seven ill-defined lines. More recently Simon and Vohsen have assigned a face-centred cubic lattice to strontium, with the constant 6·03 Å.; they believe that a hexagonal modification may be possible at high temperatures. The authors' spectra do not correspond to any cubic lattice; possibly two of the seven measurable lines might be made to agree with Simon and Vohsen's structure.

H. N. A.

35. Determination of the Crystal Symmetry Class. A. Hettich and A. Schleede. *Zeits. f. Phys.* 50. 3-4. *pp.* 249-265, 1928.

Discusses the important new piezoelectric method of Giebe and Scheibe and others for detecting the presence or absence of a centre of symmetry. The 32 crystal symmetry classes can be divided into 11 having a centre of symmetry, and 21 having no centre of symmetry. A three-page list is given of substances which have been tested by the new method. W. H. Ge.

36. Energy Transference in Compressible Liquids. A. Kneschke. *Zeits. f. Phys.* 50. 3-4. *pp.* 266-272, 1928.

A theoretical paper dealing on the lines of L. Alliévi with the propagation of energy through compressible liquids. W. H. Ge.

37. Slip-Bands of Stretched Aluminium Crystals. Part I. K. Yamaguchi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers,* 8. *pp.* 289-317, *July* 20, 1928.

A discursive account of an experimental study of the relations between the permanent strain, the resistance to slipping and the slip-bands of aluminium crystals. The usual methods, including the use of X-rays to find the orientation of the crystal axes, were employed, and the results in the main agree with those of Taylor and others. W. H. Ge.

38. Structure of Silver-Aluminium Alloys. A. F. Westgren and A. J. Bradley. *Phil. Mag.* 6. *pp.* 280-288, *Aug.*, 1928.

From powder photographs it is deduced that Ag_3Al is cubic and *isomorphous with β-manganese.* The unit cell containing 20 atoms has an edge of 6·920 Å. The other intermediate phase of the Ag-Al system is homogeneous in a range from 27 to 40 atomic % of aluminium and is a solid solution of closely-packed hexagonal structure. Its lattice dimensions change continuously from $a_1 = 2\cdot865$ Å., $a_3 = 4\cdot653$ Å., and $a_3/a_1 = 1\cdot625$ when saturated with silver, to $a_1 = 2\cdot879$ Å., $a_3 = 4\cdot573$ Å., and $a_3/a_1 = 1\cdot588$ when saturated with aluminium. The work confirms deductions of Petrenko from thermal studies. W. H. Ge.

39. Orientation of Single Crystals of Zinc. K. Tanaka. *Kyoto Coll. Sci., Mem.* 11. *pp.* 361-365, *Sept.*, 1928. *In English.*

The orientations of the axes in 119 crystals were determined by X-ray methods, and an attempt is made to correlate the results with the heat-treatment and previous history of the crystal. W. H. Ge.

40. Crystal Growth. I. N. Stranski. *Zeits. f. phys. Chem.* 136. 3-4. *pp.* 259-278, *Sept.*, 1928.

Discusses the theory of crystal growth from the point of view that the molecules, atoms or ions in the surface have equilibrium positions differing but little from the corresponding ones in the interior of the crystal, and that the position taken up by the surface molecules is such as to make the surface energy a minimum. W. H. Ge.

41. Suspensions in Crystals. F. Urbach. *Akad. Wiss. Wien, Ber.* 137. 3–4. *pp.* 147–156, 1928.

A study of foreign particles such as colloidal metals in crystals of simple inorganic salts. W. H. Ge.

42. Crystal Structure of Molluscan Shells. Part II. J. Tsutsumi. *Kyoto Coll. Sci., Mem.* 11. *pp.* 401–405, *Sept.*, 1928. *In English.*

By X-ray methods it is confirmed that the micro-crystals of calcium carbonate in the nacreous layer of *Atrina japonica* Reeve occur as an aragonite instead of a calcite, and it is found that they are arranged fibrously, the orthorhombic *c* axes of the crystals being perpendicular to the surface of the nacreous layer. [For Part I, see Abstract 3160 (1928).] W. H. Ge.

43. Micro-Crystals in Bi and Sb Deposited by Electrolysis. H. Hirata. *Kyoto Coll. Sci., Mem.* 11. *pp.* 429–450, *Sept.*, 1928. *In English.*

X-ray analysis by the transmission method. The formation of the regular arrangements of the Bi crystals seems to be influenced by two factors—current density and concentration. Small current density and low concentration favour the regular arrangement. The deposits found on the kathode are micro-crystals having the same lattice spacing as the metals. The micro-crystals of Bi in its fibrous form are so arranged that the 211 axis is parallel to the fibre axis, as is the case with single crystals of acicular form. J. E.

44. Crystal Structure of RuS_2, OsS_2, $MnTe_2$ and $AuSb_2$. I. Oftedal. *Zeits. f. phys. Chem.* 135. 3–4. *pp.* 291–299, *Aug.*, 1928.

From powder photographs it is deduced that these compounds belong to the pyrites type of structure. For $MnTe_2$ $a = 6 \cdot 943$ Å.(± 0·002), and for $AuSb_2$ $a = 6 \cdot 636$ Å (± 0·010). W. H. Ge.

45. Structure of Nitrates of Ca, Sr, Ba and Pb. F. M. Jaeger and F. A. van Melle. *K. Akad. Amsterdam, Proc.* 31. 6. *pp.* 651–655, 1928.

Reviews the conflicting evidence on the symmetry of these crystals. Rotation photographs of $Sr(NO_3)_2$ indicated a simple cubic lattice $a = 7 \cdot 80$ Å. with 4 molecules of $Sr(NO_3)_2$ in the unit cell. Space group T_h^6. Various other photographs were taken and reported and discussed, apparently chronologically. W. H. Ge.

46. X-Ray Examination of the Hydrocarbon $C_{29}H_{60}$. A. Müller. *Roy. Soc., Proc.* 120. *pp.* 437–459, *Sept.* 1, 1928.

Deals with an examination by the rotation method of a single crystal of $C_{29}H_{60}$. An orthorhombic cell $a = 7 \cdot 45$ Å., $b = 4 \cdot 97$ Å., $c = 77 \cdot 2$ Å. was found, and the structure is discussed in considerable detail, for which the original should be consulted. W. H. Ge.

47. Upper Limit for Energy Density. G. I. Pokrowski. *Zeits. f. Phys.* 51. 9–10. *pp.* 730–736, 1928.

If the principle of the additive character of energy density be adopted, there would appear to be no limit to its amount, whereas reliable evidence exists which indicates the possibility of an upper limit, and the problem is now considered as to whether this upper limit is the same as the density of matter in the atomic nucleus. For this purpose the mass of the heaviest atomic nucleus is given an energetic origin [see Abstract 2456 (1927)]. On the assumption of the existence of the upper limit, the maximum values for the temperature and frequency of radiation are derived. H. H. Ho.

48. Structure of Acetylene. J. K. Morse. *Nat. Acad. Sci., Proc.* 14. *pp.* 645–649, *Aug.*, 1928.

Using the cubical model of the carbon atom, the possible arrangements of the hydrogen atoms in the acetylene molecule are worked out and the moments of inertia of important groups of the " dynamic isomers " so obtained are evaluated. The moment of inertia, derived by Levin and Meyer from an analysis of the infra-red bands in the absorption spectrum of acetylene, equals $2{\cdot}4 \times 10^{-39}$ gm.cm.^{2}, which agrees very nearly with $2{\cdot}5.10^{-39}$ gm.cm.^{2} computed for the largest group of dynamic isomers, in which carbon and hydrogen atoms all lie in a plane. W. S. S.

49. Brownian Motions. W. Schmidt. *V.D.I.* 72. *pp.* 1191–1194, *Aug.* 25, 1928.

Mentions papers read before the Colloid Association at Essen in 1927, dealing with mist, smoke, and other aerosols, and discusses the Brownian motions observed in them and in colloids. The connection between Brownian motions and internal friction, and so with the similarity mechanics of M. Weber, is dealt with. Various conclusions are drawn from the laws of similarity as to the nature of various natural processes. Confirmations are found in the values of the exponents in the equation for adiabatic changes in monatomic, diatomic, and triatomic gases, in diffusion processes in metals, and in various facts with regard to the life of plants and animals. Limits to accuracy of measurements owing to Brownian motions are mentioned. H. N. A.

50. Anisotropy of the Carbon Atom. Kathleen Lonsdale (née Yardley). *Phil. Mag.* 6. *pp.* 433–446, *Sept.*, 1928.

A theoretical paper investigating the results of X-ray analysis of crystals of C_2Cl_6 and isomorphous compounds. A model is obtained having two A and two B valencies, geometrically different, and a comparison is made with the Main-Smith and Stoner atom. Work in other fields is also quoted in favour of a non-tetrahedral carbon atom. A critical account is given of the controversy concerning pentaerythritol and other symmetrically substituted derivatives of methane, and it is shown that in no case is a pyramidal carbon atom established. The proposed model explains the observed symmetries of other simple carbon compounds, and in some cases throws light on anomalies revealed by X-ray determinations. The paper discusses the results of 63 researches. W. H. Ge.

51. Shared-Electron Chemical Bond. L. Pauling. *Nat. Acad. Sci., Proc.* 14. *pp.* 359–362, *April*, 1928.

The factors mainly responsible for chemical valency are the Pauli exclusion principle and the Heisenberg-Dirac resonance phenomenon. Extending London's theory, the author distinguishes between polar and non-polar compounds by the following test: If the internuclear equilibrium distance calculated for a polar structure with the aid of the known properties of ions agrees with the experimental value, the molecule is polar; for a shared-electron bond this experimental distance would be smaller than the calculated value. In the case of the hydrogen halides the calculated and observed value agree only for HF; thus HF is a polar compound formed from H^+ and F^-, while HCl, HBr and HI are probably not polar, as London had already stated. This conclusion for HF is supported by the existence of the hydrogen bond. Compounds of septivalent chlorine probably contain chlorine with a polar valency of + 3 and with four shared-electron bonds. In the case of some elements of the first row the interchange energy resulting from the formation of shared-electron bonds is large enough to change the quantisation, destroying the two sub-shells with $l = 0$ and $l = 1$ of the L shell. This depends on the separation of the *s* and *p* levels of the atom corresponding to these *l* values; the separation is much smaller for boron, carbon and nitrogen than for oxygen and fluorine, and the quantisation can be changed for the first three elements, but not for the other two. H. B.

52. General Considerations concerning Modes of Chemical Linkage. H. G. Grimm. *Zeits. f. Elektrochem.* **34.** *pp.* **430–437**; *Disc.*, 442–445, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

The author classes the substances according to three types of linkage: Substances with polar, heteropolar or dualistic linkage: I. Salts [NaCl], [CaO]. Substances with unipolar linkage (homopolar or chemical linkage proper). II. Non-metallic molecules in the gas state; (*a*) without dipole moment (H_2), (Cl_2), CH_4); (*b*) with dipole moment CO, ClI, NH_3. III. Diamond type [C], [SiC], [AgI], [ZnS]. IV. Metals [Cu], [Cu_2Mg]. Substances linked by intermolecular Van der Waals forces. V. (*a*) Inert gases, condensed [Ar]; (*b*) non-metallic condensed molecules with dipole moment [H_2], Cl_2], [CH_4]; (*c*) same with dipole moment [H_2O]. The [ ] indicate solid crystallised, the ( ) gaseous substances. The position of the metals IV in this classification is uncertain. In class I the salts have ionic lattices held together by electrostatic forces; there are no molecules in the kinetic sense in the lattice; the lattice energy is of the order of 200 kg. cal. in univalent salts. The fact that there are about 70 positive and only 10 negative atomic ions is explicable by the energy relations. Other properties are discussed for this class and the other classes. There are transition states between the different modes of linkage, and on the other hand sudden jumps in the properties of compounds of the same series. H. B.

53. Significance of Atomic Models. A. Sommerfeld. *Zeits. f. Elektrochem.* **34.** *pp.* **426–430**; *Disc.*, **442–445**, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

The electrons seem to be endowed with four degrees of freedom. According to Pauli, every fully defined quantum state occurs only once in an atom, and the quantum condition of a single electron can completely be defined only by four quantum numbers. This relation can be extended to molecules and to systems of individuals of gas molecules and of metallic electrons. It shows why the electron numbers 2, 8, 18, etc., reoccur in the shells, and why there are 14 elements of rare earths. The new theories of Heisinger, Broglie and Schrödinger are compatible with the quantum theory, with one another, and with the periodic law. Schrödinger's ψ^2 function expresses the probability of the electron being in some position, and ψ indicates the density of the charge cloud. The electron is still a point charge, but it may assume many positions; the axes of the orbits correspond to the position of charge maxima in such a way that one half of the charge is inside the mean sphere of a shell and the other half outside it. The continuously-distributed charges are less arbitrary than the planetary orbits, and the modern views meet the requirements of the chemist better than the old. H. B.

54. Atomic Weight of Silver. O. Hönigschmid. *Zeits. f. Elektrochem.* 34. *pp.* 625–627; *Disc.*, 627, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

The value of Richards, Ag = 107·88, has generally been accepted since 1907, although Richards himself subsequently proposed 107·871. In the München Laboratory experiments have been made for some years by Zintl and others to determine the ratio silver/oxygen indirectly from the ratios $NaNO_3/NaCl/AgCl$, because the silver chlorate and perchlorate could not be brought to constant weight without risk of decomposition. Recently Hönigschmid and Sachtleben have found that barium perchlorate can be completely dried. All these experiments confirm the value Ag = 107·880. In the *Discussion*, **O. Hahn** inquired about the possible influence of the adsorption of matter by the crystal faces, as suggested by Kirsch in his determinations of the atomic weight of radium. The author questioned Kirsch's figures. H. B.

55. Molecular Weights of Saturated Vapours by the Effusion Method. H. Eyring. *Am. Chem. Soc., J.* 50. *pp.* 2398–2401, *Sept.*, 1928.

Describes an all-glass apparatus used for the above purpose, which makes rapid measurements possible. Accurate time and pressure measurements are necessary, and an orifice must be used which reduces viscosity effects to a minimum. The molecular weights found for a number of vapours are given; they agree quite well with the chemical molecular weights. This is true for saturated water vapour, the vapour from constant boiling hydrochloric acid and several organic vapours, so that there is no appreciable association of the molecules in these cases.

H. N. A.

56. Extension of the Group Theory of Terms. M. Delbrück. *Zeits. f. Phys.* 51. 3–4. *pp.* 181–187, 1928.

A mathematical paper dealing with certain points arising from Wigner's term theory [see Abstracts 1644, 1645, and 2663 (1927)]. W. S. S.

57. Proof of the Adiabatic Hypothesis. M. Born and V. Fock. *Zeits. f. Phys.* 51. 3–4. *pp.* 165–180, 1928.

In the older quantum mechanics the Ehrenfest adiabatic hypothesis indicated that the quantelated active variables $J = nh$ are invariant towards an infinitely slow (adiabatic) change of the mechanical system [see Abstract 568 (1927)]. This adiabatic hypothesis in the new quantum mechanics is now proved to be mathematically sound for the case of the point spectrum, and appears valid, moreover, for a transient degeneration of the mechanical system. H. H. Ho.

58. Quantum Mechanics of the Rotational Distortion of Multiplets in Molecular Spectra. E. Hill and J. H. van Vleck. *Phys. Rev.* 32. *pp.* 250–272, *Aug.*, 1928.

This paper mainly considers the effect of molecular rotation on spin multiplets, but the subject of "σ-type doubling" is also dealt with. Amplitude matrices are first given for Hund's limiting cases (*a*) and (*b*), together with phase factors for case (*b*). [See Abstracts 2013 (1926), 1271 and 2222 (1927).] The general intermediate case is dealt with by starting with case (*b*) and introducing a coupling energy proportional to the cosine of the angle between the axis of electronic spin and the molecular axis of figure. When this is increased adiabatically, the system is converted into case (*a*). For the doublet case, the analysis yields a simple closed formula for the energy, which holds throughout the interval from (*a*) to (*b*) for regular and inverted multiplets. Intensity formulæ are given which also apply throughout the same range. When there is a coupling type (*a*) initially and (*b*) finally, or *vice versa*, then a simple special case of the doublet intensity formula arises. Intensity formula for the $^2P \rightarrow {}^2S$ and $^2D_a \rightarrow {}^2P_a$ bands are developed. By introducing adiabatically a coupling proportional to the square, rather than the first power of the cosine of the angle between an angular momentum vector and a "core" of the non-gyroscopic "dumb-bell" molecular model, an elementary theory of σ-type doubling can be developed. Hulthen combination relations are shown to apply exactly, even in the worst case, when the effect of the angular momentum perpendicular to the figure axis is considered and the coupling is no longer definitely of type (*a*). This theory of σ-type doubling is primarily for singlets. R. C. F.

59. Some Recent Developments of Statistical Mechanics. J. E. Lennard-Jones. *Phys. Soc., Proc.* 40. *pp.* 320–337, *Aug.*, 1928.

A general outline is given of the classical, Bose-Einstein, and Fermi-Dirac statistics. The application of the last-named to the following problems is considered: (1) distribution of electrons in heavy atoms, (2) susceptibility of metals, (3) the electron theory of metals, (4) distribution of electrons in a metal, (5) statistics of gaseous mixtures. Under (4) the solution for the simplified case of a two-dimensional square array of atoms (obtained by the author and H. J. Woods, and to be published later) is briefly described. It appears that in addition to electrons more definitely bound to particular nuclei, there are other shared electrons which form a lattice array interpenetrating that of the atoms. W. S. S.

60. Propagation of Schrödinger Waves in a Uniform Field of Force. G. Breit. *Phys. Rev.* 32. *pp.* 273–276, *Aug.*, 1928.

The phase-difference between a Schrödinger wave refracted by a uniform field of force and the primary wave is calculated. The results are shown in a table and graphically. As the wave-length increases, the phase-difference decreases, reaches a minimum, and then increases again. It is suggested that the intensity of some crystal reflections should vary anomalously as a result. AUTHOR.

61. Test for Schrödinger's Theory. J. L. Snock, Jr., and L. S. Ornstein. *Zeits. f. Phys.* 50. 9–10. *pp.* 600–608, 1928.

Gives an account of measurements of the absorption of H_α and H_β in their fine structure. The spectra of the light from an emission tube (E), from an absorption tube (A), and that from both tubes (C), were photographed with equal times of illumination. Three curves of intensity E, A and C were thus obtained, and the index of absorption k for each frequency region $d\nu$ within an emission line was determined by means of the formula $kl = \log I_0/I = \log E/(C - A)$. In this way an absorption curve was obtained of simple form, which on the whole has the same appearance as the emission curve of the absorption tube. The ratio of the total absorption $\int k d\nu$ of H_α to that of H_β agrees with Schrödinger's theoretical value 5·37. A further test of the theory is obtained from the relations between the maxima of the doublets in absorption, the values agreeing with the theoretical ones within the limits of experimental error. H. N. A.

62. Recent Developments in Quantum Mechanics. E. U. Condon. *Science*, 68. *pp*. 193–195, *Aug*. 31, 1928.

In this paper it is pointed out that the fundamental fact for quantum physics which has emerged from experimental investigations in the field is a double duality of wave and particle concepts, the wave theory of light being now recognised as giving but one aspect of the nature of radiation, whilst its corpuscular aspect is revealed in the photoelectric and Compton effects. In these effects Planck's constant appears as a universal constant which connects the wave and particle modes of description of the same radiation. Schrödinger's work is discussed and also the developments due to Dirac and Jordan, which have given a much more general form to the mathematics of quantum mechanics. It is indicated that the reason why the classical laws of mechanics prove to be so satisfactory for macroscopic things is that the wave-lengths of the wave phenomena for them are so small that diffraction effects are negligible. H. H. Ho.

63. Assignment of Quantum Numbers for Electrons in Molecules. Part I. R. S. Mulliken. *Phys. Rev.* 32. *pp*. 186–222, *Aug*., 1928.

A tentative assignment of quantum numbers is made for most of the known electronic states of non-rotating diatomic molecules composed of atoms of the first short period; this is based mainly on band spectra and to a lesser extent on ionisation potential and positive ray data; Hund's theory is used and extended. It is possible that the results obtained may be far from correct, but they seem to correspond to some extent with the truth. The quantum numbers for a diatomic molecule seem to be related to those of an atom formed by the union of the two nuclei of the molecule when this " united atom " is placed in a strong electric field, namely four quantum numbers, n_τ, l_τ, $a_{l\tau}$ and s_τ ($s_\tau = \frac{1}{2}$ always) for the τ'th electron, and quantum numbers s, σ_l and σ_s for the molecule as a whole. The notation employed is explained, and the results obtained are tabulated. Hund has shown that some of the electrons increase their principal quantum numbers n when atoms unite to form molecules, these are spoken of as promoted electrons; on the whole promoted electrons should tend to show negative energy-bonding-power, unpromoted electrons positive, but much should depend on orbit dimensions. Rules governing the relations of the electronic states of a molecule to those of its dissociation products are discussed, also selection rules for electronic transitions. The key to the assignment of quantum numbers is found in the fact that the molecules BO, CO^+ and CN show an inverted ^2P state, instead of the normal ^2P state, as in the Na atom. This indicates that in these molecules there is a closed shell of p electrons, one of which is easily excited; it is concluded that this is a $(2p^p)^4$ shell, and other conclusions follow. It appears that the electron jumps are more analogous to X-ray than to ordinary optical electron transitions. A number of observational data are discussed in the light of the theory proposed. H. N. A.

64. Deductions from the Atomistic Constitution of Light Energy. J. Stark. *Ann. d. Physik*, 86. 8. *pp.* 1037–1040, *Aug.* 25, 1928.

The author refers to his published work on the structural and genetic connection between a light vortex and the electromagnetic field of an electron (quantum vortex) [see "Atomstruktur und Atombindung" and "Die Axialität der Lichtemission und Atomstruktur," Polytechnische Buchhandlung A. Seydel, Berlin, 1928 and 1927]. The two conclusions drawn are: (1) The time of the emission act is the same for a light vortex of given frequency and polarisation whatever its mode of production. The different decay times (Abklingzeiten) measured by Wien in canal-ray emission are attributed to the preliminary processes immediately preceding the emission. (2) A definition can be formulated of the "proper velocity" of an emitting body based on the force experienced by the body due to its own radiation. W. S. S.

65. Recent Theories of the Atom. W. F. G. Swann. *J.O.S.A. and R.S.I.* 17. *pp.* 163–197, *Sept.*, 1928.

The author gives a simple explanatory sketch of the Heisenberg matrix mechanics and Schrödinger's wave mechanics. The mathematical symbolism is examined critically and a careful distinction drawn between mere formalism and the physical assumptions underlying the theory.

W. S. S.

66. Quantum Theory of Electronic Impacts. J. R. Oppenheimer. *Phys. Rev.* 32. *pp.* 361–376, *Sept.*, 1928.

The previous treatment of electronic collisions has been incomplete, since terms in the solution corresponding to an interchange of the colliding electron with one of the electrons in the atom with which it collides have been neglected. The author evaluates the corrected first order cross-section for elastic collisions by Dirac's method for hydrogen and helium. The complete solution is worked out by Borns' method for hydrogen; the elastic cross-section varies as the reciprocal of the velocity for low velocities, tending towards infinity at zero velocity; the first order cross-section reduces to that already obtained; this is a monotonically increasing function for hydrogen, but for atoms with completely paired electrons the increase is broken by a minimum at velocities corresponding to about one volt; the higher the azimuthal quantum number of the paired valence electrons the more marked is the minimum, and the lower the voltage at which it occurs. The theory leads to the prediction that atomic hydrogen, and probably the similar alkali atoms, should show no Ramsauer effect. The problem is attacked by two different methods of wave mechanics.

H. N. A.

67. Probability Equation of Wave Mechanics. L. Goldstein. *Comptes Rendus*, 187. *pp.* 442–444, *Sept.* 3, 1928.

This mathematical paper develops a general equation of probability from the equation given by Dirac [see Abstract 1292 (1927)] for the motion of a simple atom. R. C. F.

68. General Solution of $\nabla^2\psi = \omega$ in n-Dimensional Euclidean Space. A. J. Carr. *Phil. Mag.* 6. *pp.* 241–257, *Aug.*, 1928.

In a previous paper the author postulated the existence in Euclidean space of n dimensions of the formula analogous to Green's lemma for three dimensions in the form

$$\iint\ldots\int\sum_1^n \partial U_s/\partial x_s \,.\, dx_1\,dx_2\ldots dx_n$$
$$=\iint\ldots\int\sum_1^n(-)^{n-s}U_sJ_s : du_1du_2\ldots du_{n-1},$$

where $J_s = \partial(x_1, \ldots x_{s-1}, x_{s+1}, \ldots x_n)/\partial(u_1, \ldots u_{n-1})$, and he now derives a solution of the equation $\nabla^2\psi = \omega$ by its aid. After completing this work the author found a rigorous proof, by Murnaghan ("Vector Analysis and Relativity," Johns Hopkins Press, 1922), but as the present proof adopts a different viewpoint it has been published. **Errata** (*ibid.*, *pp.* 1216–1217, *Dec.*, 1928). H. H. Ho.

69. Riemannian Geometry retaining the Notion of Distant Parallelism (Fernparallelismus). A. Einstein. *Preuss. Akad. Wiss. Berlin, Ber.* 17. *pp.* 217–221, 1928.

A Riemannian geometry introducing new invariants and tensors and retaining the notion of the parallism of finite line elements is developed. J. S. G. T.

70. Possibility of a Unitary Theory of the Gravitational and Electrical Fields. A. Einstein. *Preuss. Akad. Wiss. Berlin, Ber.* 18. *pp.* 224–227, 1928.

The theory previously developed [see preceding Abstract] is shown to afford, at least to a first approximation, a unitary theory of the gravitational and electrical fields. Separation of the two fields appears, according to the theory, to be artificial in character. Moreover, the electric field is not involved quadratically in the field equations. J. S. G. T.

71. Radiation and Relativity. Part II. G. Y. Rainich. *Nat. Acad. Sci., Proc.* 14. *pp.* 654–657, *Aug.*, 1928.

In Part I [see Abstract 2926 (1928)] the author arrived at an electromagnetic field which, while likely to accompany a light corpuscle and possessing some properties associated with light, was not periodical. In this paper a field has been obtained in which periodicity appears automatically, and whilst an example cannot be given of a non-periodic curvature field with a periodic electromagnetic field, an illustration is given of an analogous situation in flat space, *viz.*, of cases in which a non-periodic stress field determines a periodic force-field. H. H. Ho.

72. Remarks on the Second Law of Thermodynamics in General Relativity. R. C. Tolman. *Nat. Acad. Sci., Proc.* 14. *pp.* 701–706, *Sept.*, 1928.

The postulate taken, in general relativity, as the analogue of the second law of thermodynamics, is now presented in the form applicable to a non-isolated infinitesimal system, and it is shown that it can be regarded as the result of generalising the older thermodynamics. An expression embodying the results of the second law as applied to an infinitesimal four-dimensional flat space-time is first of all derived, and is considered to hold in curved space-time. The desired modification of the second law is then deduced by putting the expression into covariant form. [See Abstract 1515 (1928).] J. S. G. T.

METEOROLOGY AND GEOPHYSICS.

73. Height of the Ozone in the Upper Atmosphere. F. W. P. Götz and G. M. B. Dobson. *Roy. Soc., Proc.* 120. *pp.* 251–259, *Sept.* 1, 1928.

The results of spectrographic measurements of the heights of the ozone layer in the atmosphere at Arosa (Switzerland) are given. It was found to be most satisfactory to evaluate from curves giving the changes in the amount of 0_3 through the day, assuming the 0_3 layer to be at 0, 30, 40, 50 and 60 km., that curve which makes the average of the values obtained in the middle of the day agree as well as possible with those near sunrise and sunset. The results indicate a height between 30 and 40 km. above sea-level. The height is greatest when the amount of 0_3 is large and *vice versa*, and the height increases from autumn to spring. [See also Abstract 2003 (1927).] R. S. R.

74. Helium Content and Age of Meteorites. F. Paneth. *Zeits. f. Elektrochem.* 34. *pp.* 645–652; *Disc.*, 652, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

The author describes in detail the apparatus and method used to bring iron meteorites into solution. He determines for a number of samples the percentages of Fe, He and Ra, and from this calculates the probable age of the meteorites. He finds no meteorites with ages greater than rocks on the earth, but the helium content is high. He concludes that from a quantitative determination of He the age can be found, and although large differences in the He content are found for individual meteorites, these cannot be predicted from other results of analysis or from the structure. In the *Discussion*, **V. M. Goldschmidt** discussed the partial fusing of the Savik meteorite during part of its journey near the sun. [See Abstract 2439 (1928).] R. S. R.

75. Density of the Island of Hawaii, and Density Distribution in the Earth's Crust. R. W. Goranson. *Am. J. Sci.* 16. *pp.* 89–120, *Aug.*, 1928.

The author deals fully with the theoretical considerations for values of "g," and the corrections to be applied to the value found on account of elevation, topography and isostatic equilibrium. For the last named, geological evidence exists for lateral and vertical density distribution in the crust, heat conduction and radioactive properties provide evidence of the depth of compensation, and seismologic evidence exists regarding the strength of the crust under load. These considerations led to the adoption of a form of the Airy hypothesis, found to be in agreement with Heiskanen's. The results indicate that a continent at sea-level is compensated at a depth of about 30 km. with respect to the sub-Pacific crust, regions of higher elevation at correspondingly greater depths, and that the sub-Pacific crust differs from the continental crust in being uniformly femic down to a depth of about 60 km. The results are applied to the Pacific Islands.

The volcanic and coral islands are unstable and will approach stability by sinking. For Hawaii a sinking to a depth of 3100 m. is required to give isostatic equilibrium, but the rigidity of the crust will reduce this figure. Evidence exists that other Pacific Islands are sinking or that sinking has occurred. R. S. R.

76. Determining the Figure of the Earth by Triangulation. J. F. Hayford. *Am. J. Sci.* 16. *pp.* 121–128, *Aug.*, 1928.

The author discusses the view that in determining the flattening of the earth, arcs should be measured over a large range of latitude. He considers that progress is to be made from geodetic measures by securing large continuous areas of triangulation in convenient localities well supplied with astronomical observations. In the second part he examines the consideration that the observed ellipticity of the earth is a proof of a former liquid state. He concludes that the evidence afforded by the observed ellipticity of the earth is not sufficient to prove that the strength of the material in the earth's interior, available to resist stress-differences, has ever been so small that this material could at any time have been a liquid. R. S. R.

77. Earthquakes and their Time-Distance Curves Part I. T. Matuzawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 5. *pp.* 1–28, *Aug.*, 1928. *In English.*

The author has examined the records of a number of stations for several recent Japanese earthquakes and discusses for each earthquake the P, $\bar{P}$ and $\dot{P}$ phases of the waves found in the records and the probable depth at which the disturbance originated. He considers that the P and $\bar{P}$ waves may be generated by the release of strain energy, but the $\bar{P}$ movement may be more localised. R. S. R.

78. Long-Period Fluctuation of Barometric Gradient and Occurrence of Earthquakes in the Kwatô District, Japan. W. Inouye. *Tokyo Univ. Earthquake Research Inst., Bull.* 5. *pp.* 43–57, *Aug.*, 1928. *In English.*

The author extracted for several pairs of stations the daily pressures over a period of 3 months and determined periods of 90 days and one year. Earthquakes were found to occur rather frequently when the vector of barometric gradient is deviated to S.W. and the epicentres have a more or less definite geographical distribution. Seismic zones were found which become active alternately and complete one cycle of activity in 3 months. Dilation and contraction occur respectively in these zones. For the former zones the gravity anomalies are smaller, the rocks less magnetic, the major axis of the disturbed area runs N.E.–S.W., and the epicentric distance is less. The author considers the evidence insufficient to ascribe the occurrence of earthquakes to barometric gradient changes. The latter may be only a secondary cause or serve only as the trigger, but there is some correlation between the two phenomena as the variation is related to the tilting motion of the earth's crust. R. S. R.

79. Nature of the First Motion in the Chilean Earthquake of November 11, 1922. P. Byerly. *Am. J. Sci.* 16. *pp.* 232–236, *Sept.*, 1928.

An examination was made of the seismograms for this earthquake recorded throughout the world. The distribution of compression and rarefaction is given in detail in terms of epicentral distances and bearings. The author then explains a procedure by which this distribution can be determined, assuming that the first motion remains longitudinal in type throughout its path and that it has suffered no reflections or no possibility of a change in phase. R. S. R.

ASTROPHYSICS.

80. Physico-Chemical Considerations in Astrophysics. W. Nernst. *Frank. Inst., J.* 206. *pp.* 135–142, *Aug.*, 1928.

The author makes the assumptions: (1) The earth was split off at high temperature from the sun; (2) the universe is in a stationary state. From the earth's age (accepted as 1600 million years), and from the loss of stellar mass by radiation, he gives lower and upper limits of the sun's age as 2000 million and ten trillion years respectively; a probable age being one hundred thousand million years. For this he demands a radioactive element equal to uranium in development of heat but decomposing more rapidly. He suggests this element may be the source of the Hess-Kolhörster radiation and urges the search for it on the earth. He considers the principle of the stationary condition that demands that stellar radiation and mass be absorbed by the luminiferous ether, and urges that, conversely, strongly active elements are continually being formed from the ether, though not in amounts demonstrable to us, whose radioactive disintegration maintains the high differences of temperature observed in the universe, and restore the stationary condition. A. S. D. M.

81. Equation of the Illumination of the Field in Meridian Transit Observations. N. Stoyko. *Comptes Rendus,* 187. *pp.* 413–415, *Aug.* 20, 1928.

Pendulum corrections (C_p) at the Paris Observatory show a systematic difference depending on daylight or on lamplight illumination of the field. The author obtains the equation, $n = n_m - e$, and derives the correction to C_p as $-e\Sigma(\sec\delta - \tan\delta + \tan\phi)\ m^{-1}$, where m is the number of clock stars, this correction for Paris being of the order of $-1{\cdot}6e$. He confirms this by observing a point fixed at the focus of the eyepiece, varying the positions of the lamps, the observer and the instrument.

A. S. D. M.

82. Orbits and Masses of the Eclipsing Variable RX Herculis Compounds. R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 362. *Astrophys. J.* 68. *pp.* 51–56, *July*, 1928.

Shapley's data in 1914 from three spectrograms of the RX Herculis components are discordant with Eddington's mass-luminosity law. The author's twelve spectrograms, taken between 1925, July 5, and 1927, October 10, give (like Shapley's) circular orbits for the components but the values from the velocity curves of K_1 and K_2 are 23 and 38 % respectively greater than Shapley's values, and the masses are much smaller, agreeing better with the mass-luminosity curve. He finds that the spectral type A_0 assigned to the two stars gives a surface temperature of 10,000° T., and that the star eclipsed at primary maximum is noticeably brighter than the other. The new elements present no serious disagreement with Eddington's theory. A. S. D. M.

83. Presence of Predicted Iron Lines in the Solar Spectrum and the Terms in the Arc Spectrum of Iron. Charlotte E. Moore and H. N. Russell. *Mt. Wilson Observat., Contrib. No.* 365. *Astrophys. J.* 68. *pp.* 151–164, *Sept.*, 1928.

The predicted lines.—The positions of lines which should occur in the multiplets of Fe but have not been observed in the laboratory have been calculated. A search in the solar spectrum has revealed 289 of these lines among the previously unidentified solar lines and 41 others not completely accounted for by other elements; 57 of the predicted lines have been measured on plates of the Fe arc taken with a long exposure. The solar wave-lengths and intensities and the multiplet designations are given in Table I of the paper.

Terms of Fe I.—All the known Fe terms and combinations are listed in Table II of the paper. Here the terms are counted upwards from the zero level a^5D_4, and a uniform spectroscopic notation has been adopted, although the arbitrary symbols formerly used are also included. Improved term values derived from measures by H. D. Babcock of Fe standards on the neon scale are given for 25 terms. AUTHORS.

84. Hydrogen Chromosphere. W. H. McCrea. *Cambridge Phil. Soc., Proc.* 24. *pp.* 506–515, *Oct.*, 1928.

An approximate calculation is carried out of the line intensities to be expected in the hydrogen chromosphere if the equilibrium were radiative and governed entirely by the illumination of the chromosphere by black-body radiation from the photosphere. It is found that the line intensities differ so little from those corresponding to thermodynamic equilibrium that experimentally differentiation between the two hypotheses would be almost impossible. If, however, the chromosphere did appear to be in thermodynamic equilibrium but at a temperature slightly less than that of the photosphere radiation, the difference might be accounted for by the radiative hypothesis. W. S. S.

85. Figure of the Earth and Parallax of the Moon. W. D. Lambert. *Astron. J.* 38. *No.* 908. *pp.* 181–185, *Aug.* 14, 1928.

Lunar parallax is usually found by meridian observations of the declination at two stations, one in the northern hemisphere, the other in the southern and lying nearly in the same meridian as the first. The calculations depend, not only on the assumed ellipticity of the earth considered as an ellipsoid of revolution, but on the departures from an ellipsoid of the geoid in the neighbourhood of the two stations, namely, on the deflections of the vertical and on the distance between the geoid and the ellipsoid. Formulæ are obtained in the paper based on Chauvenet's treatment supplemented by considering the effect of irregularities in the figure of the earth. The comparison of the dynamical and the observed or geometrical parallaxes from the results of Christie and Gill, and Ross, and ways in which the differences in these quantities may arise, are discussed. R. S. R.

86. Contribution Towards a Standard System of Effective Wave-Lengths. V. Oberguggenberger. *Akad. Wiss. Wien, Ber.* 137. 2*a*. *No.* 5–6. *pp.* 275–306, 1928. *In German.*

That part of a star's spectrum which shows blackest on a photographic plate is called the effective wave-length of the star: this bears a

simple relation to the colour-index, and hence to the spectral type. Measures of effective wave-length, therefore, give valuable information for stellar statistics, and can be used for stars too faint for spectrographic determination of their spectral type. But the method has been little used, because the effective wave-length depends partly upon the instruments and plates used, upon focussing and exposure, upon the zenith distance of the star and the state of the sky. Bergstrand and Rosenberg have suggested that a standard sequence of effective wave-lengths should be formed, which should be applicable to every kind of instrument; and to this end they have selected 26 circumpolar stars, representing every stage in colour-index, and they have drawn up a programme of observation which avoids as far as possible all known sources of error. This programme has been carried out at Innsbruck. The instruments and methods are described, the chief difficulty is pointed out, and a slight extension of the observations is advised. Tables are given of the results, which agree well among themselves, and are distinctly encouraging.
M. A. E.

87. Photographic Observations of Double Stars at Harvard. E. S. King. *Harvard Coll. Obs., Circ. No.* 332. [28 *pp.*], 1928.

88. Centre of the Galaxy. H. Shapley. *Nature*, 122. *pp.* 482–484, *Sept.* 29, 1928. *Halley Lecture.*

A new determination of the centre of the Milky Way system, based chiefly on the distribution of globular clusters, indicates that it lies in galactic longitude 327° and galactic latitude 0°, in the direction of Sagittarius, but that it is almost entirely hidden behind dark nebulosities. Special researches are being made in the hope of determining the distance of these nebulosities and the nature of the centre, which may possibly be a massive nucleus like that of many spiral nebulæ. Recent spectrographic work suggests that the obscuring nebulosities are meteoric, and that the stars in their neighbourhood are partly compensated by meteoric infall for the mass they lose by radiation. M. A. E.

89. Solar Parallax Measurement. L. Rodes. *Comptes Rendus*, 187. *pp.* 527–529, *Sept.* 24, 1928.

For the period 1889–1913, the author adopts 20·358 km./sec. for the sun's equatorial radial velocity and 24·842 ± 0·011 days for its mean rotation period. Authorities are cited for these values. From the equation, solar diameter (D) in km. = [radial velocity in km./sec. × period in sec.]/π, he finds D = 1390857 km. Adopting the apparent solar diameter (α) as 31′50″·26 and the earth's radius as 6378·388 km., he finds the sun's mean distance = $D/(2 \tan\phi\ \alpha/2)$ = 149476747 km., and the solar parallax, $\pi_a = 8''\cdot 8015$. This method has the advantage of the determination of the sun's dimensions and distance from observations of its surface only, and its exactness is bound only by that of the radial velocity measures. A. S. D. M.

90. 27 Canis Majoris : Its Mass. O. Struve. *Astrophys. J.* 68. *pp.* 109–115, *Sept.*, 1928.

The spectroscopic binary 27 Canis Majoris has been regularly observed during the winter of 1927–28 with the one-prism Bruce spectrograph of the Yerkes Observatory. Observations were also made by F. J. Neubauer at the Chile station of the Lick Observatory and by R. F.

Sanford at Mount Wilson Observatory. The new spectrograms establish the fact that the period is very long, probably longer than 3·2 years and not longer than about 14 years. A short period of one day or less is not possible. The variation in the radial velocity exceeds 200 km./sec. Since the eccentricity cannot be very large, the total mass must be at least 1000 times that of the sun. The spectrum contains faint emission lines of hydrogen which are slightly variable in intensity. It is not possible, however, to explain the shifts of the absorption lines by the presence of emission. The velocity curve and other characteristics of this spectrum permit of no other interpretation than by orbital motion. The large mass leads to serious theoretical difficulties. The absolute magnitude would be much greater than can reasonably be reconciled with the spectral type, or with the faintness of the detached lines. No explanation can at present be offered for this contradiction between the results of measurements of the radial velocity and the requirements of theory. AUTHOR.

91. Contours of the Hydrogen Lines of Sirius and of Other A-Stars. C. T. Elvey. *Astrophys. J.* 68. *pp.* 145–150, *Sept.*, 1928.

The contours of the hydrogen lines of Sirius have been obtained from density-curves of single-prism spectrograms. An empirical equation of the type $I = I_0 e^{-kx}$ represents quite accurately the contours of the lines. A comparison of the observations is made with an equation of resonance absorption derived by H. von Klüber. The equations are given for the contours of the hydrogen lines of twenty other stars which are being published in the Annals of the Dearborn Observatory. AUTHOR.

92. Variation of the Radial Velocity of TU Cassiopeiæ. R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 367. *Astrophys. J.* 68. *pp.* 169–175, *Sept.*, 1928.

Fifty-nine spectrograms of TU Cassiopeiæ obtained between 1917 and 1928 furnish the data with which to relate the variation in radial velocity to the light-curve and the two available epochs of maximum light. On the assumption that light-maximum and velocity-minimum coincide, the usual relations of light-curve and radial-velocity variation for Cepheid variables are best expressed by the formula:

$$\text{Min. velocity (max. light)} = \text{J.D. } 2421503\cdot158 + 2^{\mathrm{d}}.1391\mathrm{E} + 0^{\mathrm{d}}.259(10^{-3}\mathrm{E})^2(\text{G.M.T.})$$

Although the representation is better than that given by a formula of a constant period, the irregularity in the resulting plot of the velocities suggests that superposed changes in the period or in the shape of the velocity-curve may be present. It is noteworthy that certain kindred irregularities in light are known to exist and that the period of TU Cassiopeiæ is unusual in that it falls in the minimum of the frequency-curve of periods for Cepheids as a class. AUTHOR.

LIGHT.

93. Graphical Representation of Colour Sensations. F. Allen and A. J. Fleming. *Phil. Mag.* 6. *pp.* 337–351, *Aug.*, 1928.

A diagram is used in which the effect of a given colour in exciting the three primary sensations is shown in proportion. When all three are excited equally there is the sensation of white. The diagram readily shows the amount of saturation or dilution of colours, and can be used for applying the principle of reflex inductive action to the problem of contrast. E. E. F. d'A.

94. Influence of Temperature on the Absorption of Tourmaline. P. Leroux. *Comptes Rendus*, 187. *pp.* 338–341, *Aug.* 6, 1928.

The apparatus described earlier [see Abstract 590 (1928)] was again employed, but the crystal was enclosed in an electrically heated thermostat. Values were obtained for the ordinary absorption coefficient (K_0) corresponding to a luminous vector perpendicular to the optic axis and for directions of propagation parallel and perpendicular to the optic axis, and for the extraordinary absorption coefficient (K_e) perpendicular to the optic axis. Measurements were made for wave-lengths between 5790 and 3655 Å. and temperatures 18° C. to 250° C. A linear reversible relation was found between K and t up to and between 250° and 327° C., while the angular coefficient decreases (with increase of wave-length and becomes negative) after a certain wave-length. For a zero angular coefficient the wave-length depends on the direction of vibration of the luminous vector and the direction of propagation of the light. After heating to temperatures above the limit of reversibility, the absorption is permanently decreased, and after heating to 658° C. (i) the angular coefficient for each wave-length is decreased a little in absolute value, and (ii) the wave-length corresponding to a zero angular coefficient is unchanged. R. S. R.

95. Interferometer Method of Determining Light Refraction in Crystals. P. Wulff. *Zeits. f. Elektrochem.* 34. *pp.* 611–616, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

Describes an interferometer method for the determination of refractive indices of crystals, which is suitable for crystals 0·5–10 mm. thick. The method is applicable for crystals exhibiting double refraction, whilst the three principal refractive indices can also be obtained. Experimental results obtained show excellent agreement with other published results, but this new method gives values for the refractive index to the fifth decimal place. The accuracy of the method is dependent on the crystal thickness, being higher for the thicker crystals. A description of the complete instrument is also given. R. C. F.

96. Kerr Effect in Water due to High-Frequency Radio Waves. A. Bramley. *Frank. Inst., J.* 206. *pp.* 151–157, *Aug.*, 1928.

Previous measurements of the index of refraction of water for wave-lengths between 300 and 3 cm. indicate the existence of absorption bands in this region. The Kerr effect was chosen as the most sensitive means of showing the electric spectrum of water. Curves connecting retardation and wave-number show the existence of bands. A reflecting power analogous to infra-red residual rays was shown by means of an inductance of two turns inserted into a tube of liquid, the energy reflected down the tube being measured with a thermocouple. F. S.

97. Apparent Lag of the Kerr Effect. J. W. Beams and E. O. Lawrence. *Frank. Inst., J.* 206. *pp.* 169–179, *Aug.*, 1928.

This is a continuation of previous work with the same apparatus [see Abstract 2868 (1927)]. The light transmitted through the two crossed Kerr cells was examined with a photoelectric cell. The amount of light transmitted does not accord with the assumption of an exponential discharge, but shows it to be less rapid initially and more rapid in the later stage. There is no experimental evidence for the existence of a lag of the Kerr effect behind rapidly changing electric fields. F. S.

98. Kerr Constant of Bad Insulators. W. Ilberg. *Phys. Zeits.* 29. *pp.* 670–676, *Sept.* 15, 1928.

Methods described for absolute measurement of Kerr's constant, with the aid first of constant then of varying electric fields. The former failed for want of uniformity in the results, probably due to a progressive removal of conducting particles; the latter gave uniform results. These enabled a dispersion curve to be drawn, which agrees with Havelock's formula. [See Abstract 235 (1908).] A. D.

99. Calculation of the Internal Field of Polarisation. R. de Mallemann. *Comptes Rendus*, 187. *pp.* 536–538, *Sept.* 24, 1928.

The Lorentz method of cavities for determining the internal field resulting from polarisation by an external field involves serious error when applied to molecular electro-optical phenomena, and a direct molecular method is now described applicable to any assembly of molecules. It is found that with a perfectly regular assembly the internal field is zero, and that the finite values obtained for fluids are due essentially to the irregularity of the molecular movements. H. H. Ho.

100. Existence, for a Uniaxial Crystal, of Two Different Magnetic Rotatory Powers Along and Perpendicular to the Axis. J. Becquerel. *Comptes Rendus*, 187. *pp.* 215–217, *July* 23, 1928.

For the tests tysonite was employed because its magnetic rotatory power was large compared with the effects of birefringence. The crystal was placed between the poles of an electromagnet and could rotate about a vertical axis while the electric vector of the incident wave was vertical. The azimuth of the major axis of the elliptically polarised light was found for different orientations of the optic axis of the crystal and of the magnetic field. The effects of magnetic rotation and birefringence were separated and the results represented graphically. Although magnetic rotatory powers along and perpendicular to the axis differ only to a small extent, the results obtained indicate that the difference certainly exists. R. S. R.

101. Optical Anisotropy of Atoms and Molecules. I. R. Rao. *Indian Journ. Phys.* 2. *pp.* 435–465, *July* 31, 1928.

From a study of the depolarisation of scattered light, the author concludes that the results cannot be explained by the anisotropy of the molecules unless the atoms themselves are also supposed to be anisotropic.

This is particularly obvious in the case of the inert gases, which have a depolarisation factor $r = 0 \cdot 0055$, and of a substance such as carbon tetrachloride, which has a similar factor $r = 0 \cdot 0052$, in spite of its symmetrical tetrahedral structure. Calculation then gives for the ionic anisotropy a/b the values

A 1·22	Cl^{-} 1·24	S^{--} 1·36
O^{--} 1·45 or 1·38	N^{---} 1·40 or 1·49	C^{----} 1·44.

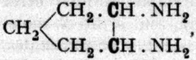
Values are also given for the deformability of these ions. Since these data are deduced on the assumption that CO_2, NH_3, N_2O and CH_4 have an ionic or salt-like structure, *e.g.*, that nitrous oxide is an oxonium nitride $O^{++++++}\ N_2^{---}$, they do not appear to rest on a firm foundation in chemistry. T. M. L.

102. Simple Method of Measuring Rotatory Dispersion. I. Bencowitz. *J. Phys. Chem.* 32. *pp.* 1163–1170, *Aug.*, 1928.

A continuous spectrum is used, but the optical mass-centre of the patch used to illuminate the field of the polarimeter is determined by calibration with a quartz plate. When made in this way the observations are found to be within 0·02° of those determined with pure monochromatic light of equal wave-length. T. M. L.

103. Spatial Arrangement and Rotatory Dispersion of Optically-Active Complex Salts of Cobalt and Rhodium. F. M. Jaeger and H. B. Blumendal. *K. Akad. Amsterdam, Proc.* 31. 6. *pp.* 637–650; 1928.

The authors have studied the products obtained by coordinating the tervalent salts of cobalt and of rhodium with the optically-active diamine



$$CH_2\left\langle\begin{array}{l}CH_2\,.\,\mathbf{CH}\,.\,NH_2\\ \qquad\quad |\\ CH_2\,.\,\mathbf{CH}\,.\,NH_2\end{array}\right.$$

, where the two asymmetric carbon atoms are shown in heavy type. When this base is used in its racemic form, the only products formed are those which contain three molecules of the lævo-base round a metal of dextro-configuration and conversely, and no indications were obtained of the less symmetrical coordination-compounds. Curves are given showing the rotatory dispersion of a number of the compounds of this series. T. M. L.

104. Scattering of Light by Particles of Metallic Oxides Dispersed in Dry Air. T. C. Nugent and H. P. Walmsley. *Phys. Soc., Proc.* 40. *pp.* 269–280, *Aug.*, 1928.

Photometric measurements were made upon samples of clouds formed by ZnO, CuO, CdO and As_2O_3, introduced into a slightly modified form of Tyndall meter, the brightness of the scattered light being measured by a Macbeth illumometer. The changes of brightness and of polarisation are shown graphically. The scattering is in no case complete as required by Rayleigh's formula, the particles thus being either not spherical, or of a diameter not extremely small compared with the wave-length of the incident light. The colour of the light and the polarisation show that the clouds are composed of ultra-microscopic particles. The changes found can be accounted for by supposing that the cloud particles disappear by aggregation and sedimentation. The curves show fluctuations similar to those for the ionisation currents in these clouds, indicating that by aggregation unstable complex particles form and periodically break up. Evidence exists that minute particles of CdO act as nuclei for the condensation process and collect CdO vapour. A series of clouds vaporised from various masses (m) of As_2O_3 has been obtained, in which the initial brightness of the Tyndall beam was approximately proportional to $m^{2/3}$. In certain clouds the rapid fluctuations in brightness appear to form groups which succeed one another at intervals by the formula $t = Ar^n$, where A and r are constants and n is an integer. [See Abstract 2129 (1927).]

R. S. R.

105. Method for Extending Microscopic Resolution into the Ultra-Microscopic Region. E. H. Synge. *Phil. Mag.* 6. *pp.* 356–362, *Aug.*, 1928.

A suggested method for extending microscopic resolution into the ultra-microscopic region is described. It consists of the employment of an intense light, such as could be furnished by an arc working under pressure, a minute orifice, approximately 10^{-6} cm. in diameter, a section which does not deviate from a true plane by more than 10^{-6} cm. and a photoelectric cell. The technical difficulties are discussed, and certain lines for their solution are given. F. J. B.

106. Ritchey-Chrétien Reflector. G. W. Ritchey. *Roy. Astron. Soc. Canada, J.* 22. *pp.* 207–230, *July–Aug.*, 1928. *Observatory*, 51. *pp.* 185–188, *June*, 1928.

The advantages possessed by this telescope are that (1) it is of general use in astronomical photography; (2) the arrangement of mirrors permits the most convenient form of equatorial telescope; (3) the principal equivalent focal ratio chosen is the best for general photographic work; (4) the small secondary mirrors are little larger than in the Cassegrainian type; (5) no obstruction occurs to the cone of light reflected from the large mirror; and (6) the telescope being compact, it is easily protected from external temperature changes; it is light and rigid, and the mounting dome and building will be small and economical. The results of a laboratory comparison of the star-images and fields of Newtonian and Ritchey-Chrétien reflectors are given. R. S. R.

107. Spot of Light Reading Device for Galvanometers. T. T. Smith. *J.O.S.A. and R.S.I.* 17. *pp.* 155–161, *Aug.*, 1928.

In the apparatus described light from a 24-c.p. lamp is focussed on the mirror by the condensing and projection lenses. The projection lens forms an image of the condensing lens on the scale, giving in this way a spot of light, while a cross-wire in front of the condensing lens serves as a reference mark. The illumination of the spot of light depends on (1) the brightness of the source, (2) the area of the galvanometer mirror, (3) the distance between the mirror and the scale, and (4) the losses by absorption and reflection in the optical system. Suitable fittings for an optical bench are described, and the set-up in an electrical laboratory and for a lecture room galvanometer is illustrated. R. S. R.

108. Methods of Sensitising Bichromated Gelatine. G. O.'t Hooft. *Zeits. f. wiss. Phot.* 25. *pp.* 394–400, *Aug.*, 1928.

Discusses the results of experiments made on bichromated gelatine sensitised with various dyes to make it sensitive to orange and red light. Dyes giving colours complementary to the colours for which the plates were required to be sensitive, were used, for these rays would then be absorbed and an action produced. R. C. F.

109. Sensitising Maturing Bodies of Gelatine. A. Steigmann. *Kolloid Zeits.* 46. *pp.* 57–59, *Sept.*, 1928.

It is shown that gelatine contains no raw sulphur compounds equivalent to the sensitiser thiocyanine. J. K.

110. Colour Printing. F. T. Hollyer. *Phot. J.* 68. *pp.* 392–395; *Disc.*, 395, *Sept.*, 1928.

Considers different methods of colour printing in which a number of copies can be printed from blocks or plates and not the single-plate printing. Hand-produced plates as opposed to photographic plates are first dealt with owing to the lack of quality in a normal photographic print in colour. The two most important methods of making printing plates by hand are wood block printing and lithography. These are briefly discussed, as is also the method Blake used for making his prints. Among the photographic methods of colour printing four are described—colour half-tone, rotary photogravure, collotype and bromoil transfer—three of which might be used by amateurs. Only the collotype process is considered in any detail, and formulæ and practical details are not dealt with throughout the paper. R. C. F.

111. Measurement of Ultra-Violet Quanta by Fluorescence Photometry. W. T. Anderson, Jr., and L. F. Bird. *Phys. Rev.* 32. *pp.* 293–297, *Aug.*, 1928.

The relative intensities of monochromatic ultra-violet light determined throughout the ultra-violet mercury spectrum by the use of a fluorescence photometer employing widely different chemical substances were shown to check the intensities of the light given by the thermopile. The agreement between the photometric and thermopile measurements indicates that both methods may be employed for measuring accurately the energy in the ultra-violet region. AUTHORS.

112. Integrating Photometer. M. G. Bennett. *Phys. Soc., Proc.* 40. *pp.* 316–319, *Aug.*, 1928.

A description of a type of integrating photometer designed to measure the total amount of light arriving at a point on the earth's surface, from the sun and sky, irrespective of the position of the sun or of the distribution of cloud. Some measurements made with it, showing the variation of direct sunlight and of indirect sunlight (arriving from clouds, etc.) throughout a typical day, are given as an illustration of its use. AUTHOR.

113. Photoelectric Photometer. J. H. J. Poole. *Roy. Dublin Soc., Proc.* 19. *pp.* 17–25, *Sept.*, 1928.

Investigations leading up to the construction of a neon-lamp photoelectric photometer, on the lines of Clarkson's paper. [See Abstracts 700 and 701 (1928).] A. D.

114. Simple Ultra-Violet Fluorophotometer. B. T. Squires and J. H. Jeffree. *Journ. Sci. Instruments*, 5. *pp.* 273–277, *Sept.*, 1928.

A simple apparatus is described by which the fluorescence under ultra-violet light of various solutions may be compared with considerable accuracy. AUTHORS.

115. Derivation of Colour Coordinates. I. Runge. *Zeits. f. Instrumentenk.* 48. *pp.* 387–396, *Aug.*, 1928.

Deals with the calculation of colour coordinates from measurements made on a trichromatic colorimeter. The Guild colorimeter [see Abstract 1002 (1926)] is first described and the method of calibration dealt with. The determination of the transformation equation from the calibration is next considered, when a numerical example is given. Means of obtaining the colour coordinates, using this transformation equation, are given, it being shown that these are only of use when plotted on a colour triangle. All possible representations of the plane methods of illustrating colours have a projective relation connecting them, and the construction of this diagram is considered. Values of the brightness and perceptibility can also be obtained, and the methods used are discussed, together with the construction of the necessary diagram. Finally, a comparison of coordinates so obtained with those obtained spectrographically is made. R. C. F.

116. Use of Photoelectric Spectrophotometry in Micro-Analysis. H. v. Halban and E. Zimpelmann. *Zeits. f. Elektrochem.* 34. *pp.* 387–393, *Aug.*, 1928.

The use of the photoelectric spectrophotometric method of micro-analysis, owing to its advantages over other methods, is shown to be very sensitive. Two examples of the possibilities of this method are given in the estimation of iron, as the ferric ion, with thiocynate, and the estimation of titanium as peroxide. Experimentally it is shown that in a 50 cc. solution an accuracy of 1 % can be easily obtained in the estimation of 0·001 mg. of iron or 0·01 mg. of titanium. The existence of quantities as small as 0·00002 mg. of iron and 0·0001 mg. of titanium can also be definitely shown. R. C. F.

117. Fluorescence of Fluorspars Excited by Light of Different Wave-Lengths. H. Nisi and K. Miyamoto. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 357–360, *July*, 1928.

Fifteen crystals from different localities have been examined, and are found to show three types of fluorescence: blue and red, blue only, and none appreciably. The first group only is dealt with. The principal lines fall into two groups: one is excited by about 2300 Å., the other by about 2800 Å. Comparison with the results of Urbain on kathodo-luminescence indicates that the first group is due to samarium and the second probably to europium and terbium. J. E.

118. Anti-Stokes Radiation of Fluorescent Liquids. R. W. Wood. *Phil. Mag.* 6. *pp.* 310–312, *Aug.*, 1928.

Exceptions to Stokes' law in the case of the fluorescing vapours of sodium, iodine, etc., are quite common, but though its existence has been established by Nichols and Merritt in the case of solutions of organic dyes, no photographs appear to have been published. The present author now gives photographs showing the presence of the anti-Stokes radiation in a very dilute solution of fluorescin (alkali-salt) rendered slightly turbid with a precipitate of silver chloride, the liquid being illuminated in a square bottle with the beam of light from a two-prism monochromator. With blue light excitation the fluorescence was very bright, and an exposure of half a minute was sufficient. It is found that in general the effect of high temperature is to decrease the fluorescence of organic dyes, this result being contrary to that obtained with sodium and iodine vapours. The results are discussed from the point of view of the principles of the quantum theory. T. B

119. Band Fluorescence of Mercury Vapour. S. Mrozowski. *Zeits. f. Phys.* 50. 9–10. *pp.* 657–690, 1928.

It is shown that the alteration in the structure of the fluorescence bands with density is due to re-absorption, but that the weakening of the fluorescence on strong heating is due to a weakening of the absorption. Any absorption line of the absorption bands can excite the fluorescence, but the structure of the fluorescence spectrum depends on the mode of excitation. An ultra-violet emission band has been observed which is discontinuous, and whose terms can be accounted for by a single oscillation state. A detailed discussion of the results shows a relation of the bands to the 2^3P state, and from the place of convergence of the bands the heat of dissociation of the mercury molecule is found to be 15 kg.-cal. A few observations are recorded on the influence of added gases. J. E.

120. Decay of Mercury Fluorescence excited by the Mercury Line 2536. S. Pienkowski. *Zeits. f. Phys.* 50. 11–12. *pp.* 787–792, 1928.

The green fluorescence of mercury vapour in a moving steam of vapour was excited by the Hg line 2536. The distance of the darkening from the line of the exciting beam gives the time of decay. This is $2{\cdot}4$ to $5{\cdot}1 \times 10^{-5}$ sec., and is the same for Al spark excitation. It seems that the green fluorescence is caused by absorption in the 2540 band. J. E.

121. Fluorescence and Photochemical Change. K. G. Mathur and S. S. Bhatnagar. *Indian Journ. Phys.* 3. *pp.* 37–51, *Sept.* 30, 1928.

Fluorescent solutions of eosin, uranine and quinine sulphate lose their power of fluorescence when exposed to sunlight, and the change is retarded when the colloidal particles are protected by gelatine (or NaOH). Exposure to light in the absence of air, however, showed no effect on the fluorescing power. This was confirmed by measurements on the change of absorption spectra and refractive indices. It appears that the photo decomposition of dyestuffs is probably an oxidation process which has nothing to do with fluorescence. J. E.

122. Chemiluminescence of Aminopthallic Acid Hydrazide. H. O. Albrecht. *Zeits. f. Phys. Chem.* 136. 5. *pp.* 321–330, *Sept.*, 1928.

This gives on oxidation in alkaline acid solution a chemiluminescence of great intensity, as do also allied substances. A spectral investigation gave no positive results on the mechanism. J. E.

123. Welsbach Light Source. K. Wurm. *Zeits. f. wiss. Phot.* 25. *pp.* 365–379, *Aug.*, 1928.

The object of the work described was to obtain an explanation of the light emission of the Welsbach light source. A careful comparison of the arc and spark spectra of various metals with those obtained from Welsbach's apparatus was made. The results show that the lines obtained coincide with the normal arc and spark lines. An examination of the intensities of the spectrum lines in the three cases shows that the Welsbach source represents the approach of the arc discharge to the spark discharge, and that by increasing the voltage this approach can be continuously carried further. R. C. F.

124. Absorption of Ultra-Violet Light by the Glucosans. L. Kwieciński and L. Marchlewski. *Acad. Polonaise Sci. et Lettres, Bull.* 6–7A. *pp.* 263–269, *June–July,* 1928. *In English.*

As the glucosans contain two "rings," selective absorption might be expected. With α-glucosan a distinct band with the maximum at $\lambda = 2810$ becomes prominent as purification proceeds. Though the non-purified β-glucosan also shows a band at $\lambda = 2695$, the band fades in the course of purification, the mother liquor, however, showing the absorption band more and more clearly as the impurities accumulate therein. [See Abstract 1216 (1928).] J. K.

125. Absorption of Ultra-Violet Light by Arabinose, Maltose, Saccharose, Rafinose, and by Mannitol and Dulcitol. L. Kwieciński and L. Marchlewski. *Acad. Polonaise Sci. et Lettres, Bull.* 6–7A. *pp.* 272–282, *June–July,* 1928. *In English.*

Confirming their earlier researches on the aldoses, such as glucose and galactose, the experimenters now find that so long as the aldoses investigated in this further research are pure no selective absorption is obtained. [See Abstract 1216 (1928).] J. K.

126. Light Absorption of Strong Electrolytes. H. v. Halban. *Zeits. f. Elektrochem.* 34. *pp.* 489–497; *Disc.*, 518–520, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

Previous work on the analogy between conductivity and light absorption of strong electrolytes is first discussed. Experiments illustrated by 16 curves are then described for the case of an absorbing anion and a non-absorbing cation, various mixtures of nitrates being investigated. It was found that every cation exerted a specific change on the absorption spectrum, whereas the anion has the same quantitative influence in different solutions. The deformabilities of the different cations and anions examined are found to be expressed by the series:

$$\mathrm{Cu^{\cdot\cdot}, Ni^{\cdot\cdot}} > \mathrm{NO_3'} > \mathrm{Ca^{\cdot\cdot}, Ba^{\cdot\cdot}},$$
$$\mathrm{K^{\cdot}, Rb^{\cdot}, Cs^{\cdot}, NH_4^{\cdot}, Na^{\cdot}} > \mathrm{NO_3'} > \mathrm{Na^{\cdot}, Li^{\cdot}}.$$

The paper should be consulted in its entirety. H. H. Ho.

127. Absorption Spectrum of Iodine in Ethyl Alcohol. A. Batley. *Faraday Soc., Trans.* 24. *pp.* 438–452, *Aug.*, 1928.

Investigation of the ultra-violet and visible absorption exhibited by solutions of iodine in alcohol shows that, in agreement with Stobbe and Schmidt's suggestion [*Zeits. wiss. Phot.* 20. *p.* 57, 1920], the maxima recorded by previous authors at about 360 and 290 $\mu\mu$ in the ultra-violet spectra are due to the formation of hydrogen tri-iodide in the solution. The true absorption curve for alcoholic iodine solutions between the wavelengths 250 and 720 $\mu\mu$ in presence of ozone, which decomposes the hydrogen iodides as formed, shows only one maximum, at 447 $\mu\mu$ ($e_{\mathrm{max.}} = 9\cdot54 \,.\, 10^5$), with general absorption in the far ultra-violet. The hydrogen tri-iodide may be isolated in the solid form on gelatine, and

then exhibits an absorption maximum at 368 $\mu\mu$. The mechanism of the formation of this compound is studied spectro-photometrically, and it is found that, in general, solutions of iodine in alcohol are subject to the opposing reactions: (*a*) the photochemical reaction between iodine and alcohol, giving hydrogen iodide and tri-iodide, and (*b*) the photochemical oxidation of the hydrogen iodides by dissolved oxygen; the relative velocities of these two reactions are influenced by various factors. The form of the absorption curve will, therefore, depend on the mode and speed of observation, on the light source used, on the purity of the solvent (with regard to its water content), on the dilution of the solution, and on exposure of the solution to daylight, either before or during examination.
T. H. P.

128. Absorption Spectra of Solutions of Cobalt Chloride, Bromide and Iodide. W. R. Brode and R. A. Morton. *Roy. Soc., Proc.* 120. *pp.* 21–33, *Aug.* 1, 1928.

The absorption spectrum of cobalt chloride in hydrochloric acid has been examined with the same spectrophotometer as previously used [see Abstract 1610 (1928)] in the region 4000 to 6000 Å., and the same frequency difference (12·28 fresnels) is found between the bands as in the region 6000 to 7200 Å. The spectrum of cobalt bromide in hydroflouric acid when similarly examined is found to show a frequency difference of 11·70 f. For the examination of cobalt iodide in hydriodic acid between 5000 Å. and 9000 Å., the visual photometer was supplemented with a Hilger rotating sector and a specially designed spectrograph, the plates being read with a Moll microphotometer. The frequency difference in this case is found to be 10·79 f.
F. S.

129. Optical Investigation of Perylene and its Derivatives. Part I. Visible Absorption Spectrum of Certain Simple Derivatives. A. Dadieu. *Zeits. f. phys. Chem.* 135. 5–6. *pp.* 347–361, *Aug.*, 1928.

The results of measurements of the visible absorption bands of perylene and some of its derivatives in benzene solution, expressed in tabular and curve form, show that the influence of the substituents, Cl, Br, $CO . CH_3$, $CO_2C_2H_5$, $CO . C_6H_5$, and $CO . C_6H_4Cl$, on the absorption bands is threefold: (1) Displacement of the bands towards greater wave-lengths; (2) broadening of the bands, and (3) diminution in intensity. Proportionality is exhibited between the extent of the broadening and the number of the sheath electrons of the substituent, the outer layers having preponderating effect. The decrease in intensity seems to run parallel to the broadening. It is supposed that the electron affinity of the substituent and the structure of its electron shell (number and energy level of the shell electrons) are responsible for the displacement of the band maximum.
T. H. P.

130. Absorption Spectra of Benzene Derivatives. J. Errera and V. Henri. *J. de Physique et le Radium*, 9. *pp.* 205–224, *July, and pp.* 249–264, *Aug.*, 1928.

The absorption of a number of di-halogen derivatives of benzene in a state of vapour has been examined in the ultra-violet. Two electronic states of ionisation have been found for chlorine and bromine compounds, but one only in the case of iodine derivatives. The spectra of the first state of activation consist of a series of doublets, and in addition a state of vibration of the atoms in the molecule is set up. There are two intramolecular vibrations in the case of ortho- and meta-compounds, and three for para-derivatives. The rotation spectra are very banded, and correspond to a large moment of inertia of the molecule. In the case of dichloro-benzene, the difference of the moment of inertia for the normal and ionised molecules is about 11×10^{-40}. Numerous tables of band values are given. F. S.

131. Absorption Spectra of Water and Ice, with Reference to the Spectra of the Major Planets. J. C. McLennan and A. C. Burton. *Roy. Soc., Proc.* 120. *pp.* 296–302, *Sept.* 1, 1928.

The absorption of water with columns 4, 21, 5 metres long, has been observed, using plates sensitised with dicynanine. There are three bands in the red, identified with bands in the planetary spectra. Fourteen metres of ice give a markedly different spectrum, the intensities being shifted towards the red. It is concluded that the absorption in the red common to the four major planets can be attributed to water in the liquid state, although water vapour at very low temperatures might explain the effects. The absorption in the green at 5430 cannot be explained by water, and search is being made for it in the absorption of certain liquefied gases. J. E.

132. Absorption Bands in the Spectra of Mixtures of Metallic Vapours. R. K. Waring. *Phys. Rev.* 32. *pp.* 435–442, *Sept.,* 1928.

Evidence of the existence of HgTl molecules in the vapour state.—It is shown by experiment that at a given temperature the amount of thallium in the vapour state is increased by adding mercury vapour. This indicates definitely that thallium-mercury molecules are formed.

Absorption bands of HgTl molecules.—In a mixture of thallium and mercury vapours a number of bands appear in absorption which are to be attributed to the HgTl molecule. In no case was the resolving power sufficient to show structure. Asymmetric broadening of the atomic Tl lines and of the Cd line 2288 due to Hg vapour has been observed. Two possible explanations are discussed: broadening due to a superimposed molecular band, and broadening due to transfer of kinetic energy by collisions.

Absorption bands of InCd molecules.—Absorption bands due to InCd molecules were observed in mixtures of In and Cd vapours at temperatures of 400°, 500° and 800° C. Their short wave-length limits are tabulated. A few showed traces of their structure, but the resolving power was not sufficient to make measurements possible. AUTHOR.

133. Raman Effect. P. Pringsheim and B. Rosen. *Zeits. f. Phys.* 50. 11–12. *pp.* 741–755, 1928.

The Raman spectra are observed by irradiation with a quartz lamp of several simple organic compounds: methylene chloride, chloroform, carbon-tetrachloride, acetylene dichloride, tetrachlorethylene, acetylene-tetrachloride, benzol, monochlorbenzol, and toluol. By comparison with the infra-red band spectra of these substances an infra-red frequency can be found to correspond to each Raman shift, but not always *vice versa.* Anti-Stokes lines are quite frequent (*i.e.*, Raman lines on the violet side of the exciting line, corresponding to $\nu + \nu_0$), and they fall off rapidly in intensity with increasing shift. The Raman spectrum of $SiCl_4$ is very weak, and not recognisably similar to that of CCl_4. Using crystalline quartz a number of shifted lines are observed, but they are only partially in agreement with known infra-red frequencies. When quartz glass is used, no shifted lines appear. A. C. M.

134. New Class of Spectra due to Secondary Radiation. C. V. Raman and K. S. Krishnan. *Indian Journ. Phys.* 2. *pp.* 399–419, *July* 31, 1928.

An earlier paper [see Abstract 2368 (1928)] announced the discovery of a new type of secondary radiation produced whenever light is diffused by the molecules of a transparent medium, the scattered radiation containing not only the wave-lengths present in the incident light, but also radiations of modified frequency. The phenomenon is being investigated in detail, and the present paper gives photographs of the scattered spectra from benzene, toluene, pentane, ether, methyl alcohol and water. General similarities are shown by liquids containing chemically similar groups. In the case of benzene, where the scattered spectrum has been measured and analysed, there are seven modified lines corresponding to each line in the incident light. The shift of frequency of the modified lines is found to agree with certain characteristic infra-red frequencies of the molecule. The tentative explanation of the phenomenon given in the previous paper is confirmed. The relation between the modified scattering of light and the structure of the molecule will form the subject of a separate paper. T. B.

135. Raman Effect in Glycerine and Glycerine-Water Mixtures. S. Venkateswaran. *Indian Journ. Phys.* 3. *pp.* 105–122, *Sept.* 30, 1928.

The new type of secondary radiation discovered by Raman and exhibited by all transparent media [see Abstract 2368 (1928)] has been studied by the author in glycerine and glycerine-water mixtures. The spectrogram of the scattered light from a quartz mercury lamp consists of a bright continuous spectrum and a number of modified lines. The latter have been measured and analysed. It is found that the shift of frequency of the modified lines correspond to certain characteristic frequencies of the molecule. The strong continuous spectrum observed in glycerine is shown to be characteristic of the pure liquid. Its intensity diminishes on dilution, and appears to be intimately connected with the high viscosity of the liquid. Micro-photometric records and photographs of the effect are given, showing the positions of the modified lines in the scattered spectrum. When only the 4358·3 group of lines are incident, nine modified lines ranging from 4268·2 to 4994·0 are photographed and tabulated. T. B.

136. Raman Effect in Crystals. I. R. Rao. *Indian Journ. Phys.* 3. *pp.* 123–129, *Sept.* 30, 1928.

An experimental record of work on the measurement of the position of the new lines in the spectrum of the diffused radiation from ice and other crystals. The Raman explanation that the difference in frequency between the incident and modified radiation should correspond to a characteristic frequency of the medium is vindicated, the difference corresponding to the characteristic infra-red frequencies of the crystals. The Raman effect thus affords a convenient method for the study of the optical

properties of crystals in the infra-red. Ice gives sharper bands of shorter wave-length than water. Crystalline quartz also gives very sharp, well-defined bands. The paper is illustrated by a plate of the spectra measured.
S. G. B.

137. Raman Effect in Gases and Vapours. L. A. Ramdas. *Indian Journ. Phys.* 3. *pp.* 131–136, *Sept.* 30, 1928.

The paper describes a successful attempt to photograph the Raman effect [see Abstract 2368 (1928)] in ether and ether vapour at room-temperature. A specially constructed spectrograph, 10 to 15 times as fast as the ordinary instruments was used, and a blue-violet filter not transmitting wave-lengths longer than 4358·3 Å.U. The change of wave-length in scattering is found to be the same in ether liquid and ether vapour. The intensity of the new radiation is found to be proportional to the density (*i.e.*, to the number of molecules) of the scattering medium, indicating that the individual molecules are the entities concerned in the phenomenon. Some preliminary observations on the modified scattering in CO_2 liquid and vapour are also described.
T. B.

138. Raman Effect in Xylol. C. E. Bleeker. *Zeits. f. Phys.* 50. 11–12. *pp.* 781–786, 1928.

Several organic liquids have been tested, both by focussing light into the interior with a lens and also by Wood's method, the latter giving much shorter exposures. Wave-lengths and intensities of the new lines which appear in the scattered light have been measured, and their possible relations to the known exciting mercury lines are given, as well as a comparison with the infra-red absorption bands.
F. S.

139. Studies in the Infra-Red Region of the Spectrum. Parts I, II, III and IV. R. Robertson and J. J. Fox. *Roy. Soc., Proc.* 120. *pp.* 128–210, *Aug.* 1, 1928.

A detailed account is given of the infra-red absorption spectrum up to wave-lengths of 17 μ, of the gases arsenic hydride, phosphine and ammonia. Parts I and II describe the prism spectrometer, observation tubes, sources of radiation and other apparatus. Part III. The following sequences of oscillation bands were found: Main sequence, a nearly harmonic sequence, intensity decreasing towards the visible, each band characterised by an intense zero (Q) branch, with less intense side branches (P and R). Second sequence, bands occurring at approximately intermediate positions between bands of main sequence. Third sequence, originating in Q branches of the fundamental bands of the main sequence, not represented in NH_3. Sequence X (rotation?), occurs only for NH_3, simply related to the band *a* of NH_3 found by Rubens and Wartenberg at about 63 μ. Band 10·55 μ, NH_3 only, peculiar in having two Q branches close together, no members associated with it in simple harmonic fashion as far as 17 μ. The details of the rotation maxima where resolved are given in full. Part IV contains a discussion of the interrelations of the bands in one gas, and of the corresponding bands in the different gases. From the fine structure of the resolved bands the moments of inertia are calculated, and these, together with the general features of the band structure, are considered in connection with molecular models for NH_3, PH_3 and AsH_3, notably Hund's suggested tetrahedral arrangement.
W. S. S.

140. Progression Relation in the Molecular Spectrum of Oxygen occurring in the Liquid and in the Gas at High Pressure. O. R. Wulf. *Nat. Acad. Sci., Proc.* 14. *pp.* 609–613, *Aug.*, 1928.

Gives a table containing the band limits observed by Ciechomski in liquid oxygen and in the gas at high pressure, with the numbers assigned by him to the bands. The author considers that certain of these bands form a progression. In the following table the first line gives Ciechomski's band numbers, and the second the author's progression numbers for nine bands, which follow one another with a certain regularity:—

8	9	10	11	12	13	14	15	16	17	18	19	20
			1	2		3	4	5	6	7	8	9

Graphs are given showing the relation between the positions of the nine bands and the band numbers, and between the first differences between the wave-lengths and the band numbers. Extrapolation indicates that the continuous absorption begins in the neighbourhood of 2350 Å., at about the 19th band in this arbitrary numbering. This absorption is believed to be due to the molecule O_4, and to correspond to the oscillation $O \leftrightarrows O_3$.
H. N. A.

141. Zeeman Resolution of the Oxygen Spectral Line at λ5577 Å. J. C. McLennan, J. H. McLeod and R. Ruedy. *Phil. Mag.* 6. *pp.* 558–566, *Sept.*, 1928.

From the experimental work reported in detail, it is concluded that the green line at λ5577·341 Å. in the spectrum of oxygen must have its origin in electronic transitions from $'S_0$ metastable levels of oxygen atoms to $'D_2$ ones.
W. H. Ge.

142. Ultra-Violet Absorption Bands of Oxygen. A. S. Ganesan. *Indian Journ. Phys.* 3. *pp.* 95–104, *Sept.* 30, 1928.

The paper deals with the structure of the five ultra-violet absorption bands of oxygen, λλ1946–1953, λλ1923–1934, λλ1902–1920, λλ1882–1897 and λλ1864–1878. The lines in the bands are given by the well-known relation of the type $\nu = A + 2Bm + Cm^2$. The band-heads are given by $\nu_0 = 49350 + 708n - 13n^2$, where n has values from 3 to 7.
AUTHOR.

143. Active Nitrogen. A. E. Ruark. *Phil. Mag.* 6. *pp.* 335–336, *Aug.*, 1928.

A discussion of the difference in the results obtained by Okubo and Hamada [see Abstract 1611 (1928)] and by Ruark, Foote, Rudwick and Chenault [see Abstract 1755 (1927)]. These are attributed to a difference in pressure, the lower pressure used by the latter workers tending to minimise secondary effects.
F. S.

144. Variations in the Fine Structure of H_α. G. E. Harrison. *Phys. Soc., Proc.* 40. *pp.* 300–306, *Aug.*, 1928.

The present paper describes the results of an attempt to study the intensity changes taking place in the fine structure of H_α with alteration of the bore of the discharge tube at constant gas pressures and current densities. The large variations in the electric field surrounding an emitting particle are concluded to account for the observed changes in the intensity distribution which amounted to 100 per cent. The doublet separation, however, appeared to be independent of these changes, the mean value obtained being $0 \cdot 304$ cm.$^{-1}$.
AUTHOR.

145. New Bands in the Secondary Spectrum of Hydrogen. D. B. Deodhar. *Phil. Mag.* 6. *pp.* 466–479, *Sept.*, 1928.

Some bands in the yellow have been described by Curtis [see Abstract 1332 (1926)]. Another distinct group has been noticed on a microphotograph, and the values listed. The branches are discussed, and tables of differences and initial and final terms given. It is concluded that the bands are emitted by the excited H_2 molecule. F. S.

146. Extinction of the D-Lines in Flames by the Addition of Chlorine. J. Franck and G. E. Gibson. *Zeits. f. Phys.* 50. 9–10. *p.* 691, 1928.

Describes visual observations of a blow-pipe flame fed with salt, when the vapour of carbon tetrachloride is passed into the flame. There appeared to be complete parallelism between the extinction of the D-lines and the disappearance of sodium absorption. This seems to indicate that the disappearance of the D-lines is practically due to the disappearance of free sodium atoms in the flame. H. N. A.

147. Spectrum of Potassium Excited by Combination with Chlorine. L. A. Ramdas. *Indian Journ. Phys.* 3. *pp.* 31–36, *Sept.* 30, 1928.

Foote, Meggers and Mohler [see Abstract 1604 (1922)] have shown the development of the potassium spectrum through the stages of simple line and arc spectra to the enhanced spectrum by an electrical method. The spectrum of potassium burning spontaneously in chlorine has been studied with a quartz spectrograph and the results tabulated. In addition to the arc spectrum and a few enhanced lines, there is an intense band in the red. An explanation is considered from the point of view of thermal excitation. F. S.

148. Approximation Method and Application to some HCl Bands. D. G. Bourgin. *Phys. Rev.* 32. *pp.* 237–249, *Aug.*, 1928.

This approximation method, which is applicable to some experimental investigations, is based on the inversion for $\mu(\nu)$ of the integral equation $A(x) = \int_0^\infty (1 - e^{-\mu(\nu)x})d\nu$. The author describes the general nature of the interdependence of $A(x)$ and $\mu(\nu)$, and then sufficiently develops a practical method of characterising certain types of $\mu(\nu)$ to allow of immediate application. Previously published data for the HCl fundamental band lines [see Abstract 2892 (1927)] is approximated by line patterns based on the hypothesis of (*a*) a Doppler broadening, (*b*) a Stark broadening, and (*c*) an interrupted absorption process; the values of the line intensities and breadths and Einstein coefficients A_{01} and B_{01} are given for each of the assumed structures. The Doppler effect is shown as unlikely to be the primary influence as regards line shape, but the Lorentz line with the Doppler broadening appears to be in agreement with the results. Dielectric-constant measurements indirectly lead to approximately the author's values for $\int_0^\infty \mu(\nu)d\nu$, further supporting van Vleck's criticism of that explanation of the discrepancy between extrapolated optical and direct measurements of this dielectric constant, which depends on the infra-red vibration bands. Recent work on the coupling effect in gases is examined, and Badger's measurements on the pure rotational spectrum of HCl, assuming a line structure derived on the basis of " coupling " pressure broadening, are studied, but without much success. R. C. F.

149. Isotope Effect in the Iodine Monochloride Bands near Convergence. G. E. Gibson. *Zeits. f. Phys.* 50. 9–10. *pp.* 692–696, 1928.

It has previously been shown that the iodine monochloride spectrum is very similar to those of the halogens, and shows a distinct convergence of bands at 5144 Å. followed by a continuous absorption. A new photograph shows a series of additional bands, which appear to have the same convergence point. It is shown that while the original set of bands are due to ICl_{35}, the new set is due to ICl_{37}. The Sommerfeld quantum condition for the unharmonic oscillator is considered in arriving at this conclusion. H. N. A.

150. Extreme Ultra-Violet Spectrum of Argon Excited by Controlled Electron Impacts. K. T. Compton, J. C. Boyce and H. N. Russell. *Phys. Rev.* 32. *pp.* 179–185, *Aug.*, 1928.

Recent work by the authors on the spectrum of neon has showed that excitation by electrons from a hot kathode in gas at low pressure was effective for obtaining the first spark spectrum. The same apparatus was employed in the case of argon, using various voltages up to 150 volts, with gas pressures of about 0·05 mm. Hg and currents of about 100 mA. The excitation arises from single rather than multiple electron impacts. A high vacuum spectrograph with glass grating was used, and 88 lines of argon were photographed in the region 1066 to 461 Å.; 20 of these belong to the arc spectrum, 44 of the 68 spark lines are new, no previously known ArIII lines were excited, 37 of the spark lines have been classified, 12 of these classifications have been checked by numerous combinations involving lines in the region 6883–2300 Å. The term arrangement of ArII is similar to that of NeII, but in NeII only terms involving a displaced *s* electron exist in the group of next higher energy above the fundamental $2p^2P_{12}$ state, while in ArII both 4*s* and 3*d* excited electron configurations exist at about the same levels above the fundamental $3p^2P_{12}$ state, so that the structure of the spectrum is very much more complicated. The ionisation potential is 27·82 ± 0·05 volts; adding the first ionisation potential of 15·69 volts, the minimum potential for double ionisation is 43·51 volts; this is to the $^3P_2$ limit, the lowest energy state of ArIII.
H. N. A.

151. Appearance of the Balmer Lines by Addition of Argon. E. Hiedemann. *Zeits. f. Phys.* 50. 9–10. *pp.* 609–617, 1928.

From a consideration of previously published work, the influence is discussed of the addition of argon on the excitation of the hydrogen spectrum. In order to understand the action of this added argon on the ionisation and recombination phenomena, these are considered to take place without occurrence of excitation. In view of the known data, a simple explanation is given of this action of added argon, which is in good agreement with the experimental results obtained by the author. R. C. F.

152. Spectra of NeII and ArII. T. L. de Bruin. *K. Akad. Amsterdam, Proc.* 31. 6. *pp.* 593–602, 1928.

In a former paper [*ibid.* 31. 1. pp. 2–13, 1928] 180 lines of NeII, measured by L. and E. Bloch and Déjardin, have been classified in a term-scheme. Measurements have since been made [see Abstracts 1270 and 1915 (1928)] on the spectra of NeII and ArII. A comparison is here made of the deep quartet terms in these spectra, nearly all those predicted by Heisenberg and Hund's theory having been identified. The Zeeman effect for a number of ArII lines has been calculated and the results compared with those of Lüttig. F. S.

153. Series Relations in the Neon Spectrum. Y. Ishida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, 9. [3 *pp*.], *Aug*. 7, 1928. *Supplement*.

The Stark effects for various series lines of neon do not appear to accord with the Paschen classification, particularly in the case of the *p–d* combinations. A. C. M.

154. Spectra of Neon, Argon and Krypton. W. Gremmer. *Zeits. f. Phys*. 50. 9–10. *pp*. 716–724, 1928. *From the Reichsanstalt*.

New lines are found in the red and infra-red belonging for the greater part to already known *sp*, *ps*, or *pd* series. The krypton spectrum has several constant frequency-differences, and exhibits a similar appearance to the structure of the neon and argon spectra. These regularities make it possible to analyse the krypton spectrum. A. C. M.

155. Absorption in Excited Krypton and Xenon. J. C. McLennan and R. Ruedy. *Roy. Soc. Canada, Trans*. 22. *Sect*. 3. *pp*. 15–26, *Jan*., 1928.

Light from a Geissler tube containing the rare gas was passed through an absorption tube, 10 cm. long and provided with Mg electrodes, filled with the same gas at about 1 mm. pressure. The absorption spectrum in the near infra-red was photographed with neocyanine plates. Tables are given of the lines of Kr and Xe found in absorption. The energy levels of Kr and Xe correspond to the arrangement of the higher energy levels in Ne and Ar. In addition, the group of Na^+ lines in the violet has been shown to correspond to the red neon lines $2p_j–s_i$. F. S.

156. Structure of the Induction Spectra of Rare Gases—Arc Spectra of Argon, Krypton and Xenon. A. T. Williams. *Phys. Soc., Proc*. 40. *pp*. 312–315, *Aug*., 1928.

See Abstract 1294 (1928).

157. Production of the Helium Spectrum by Electrical Excitation. L. S. Ornstein, H. C. Burger and W. Kapuscinski. *Zeits. f. Phys*. 51. 1–2. *pp*. 34–50, 1928.

The effect on the stronger lines of helium of alterations of the conditions under which they are produced has been investigated; the current through the Geissler tubes employed, the pressure of the gas and the diameter of the capillary of the Geissler tube have been varied; curves have been drawn showing the manner in which the intensities of the lines vary under these varying conditions, a direct vision glass monochromator and a Moll-Burger vacuum thermoelement being employed, except in the case of line λ20582 Å, for which an echelette grating was used. A study of the curves shows that the 2^3P state is not chiefly produced by ionisation, and it seems probable that the same is true of the other states involved. Direct excitation by the collisions of electrons, particularly at low pressures, and collisions with other atoms in addition at higher pressures, are the most important factors. The effect of absorption in the gas is very marked. The relation between the intensities of triplet and singulet lines with different currents and with varying pressure is dealt with; also the selection principle for excitation by electronic collisions which is analogous with that for radiation. H. N. A.

158. Zeeman Effect in the Band Spectrum of Helium. W. E. Curtis and W. Jevons. *Roy. Soc., Proc.* 120. *pp.* 110–127, *Aug.* 1, 1928.

Using the third order spectrum of an 8-ft. concave grating and a Fabry-Perot 1-cm. étalon, the Zeeman effect in two regions of the helium band spectrum was investigated for fields up to 20,000 gauss. In many cases the band lines showed broadening sometimes considerable in amount, and in one case resolution of the magnetic components was effected. A double image prism enabled some information to be obtained as to the polarisation of the components. The theoretical prediction of a rapid decrease in the width of the Zeeman pattern with increase of rotation, for bands due to transitions between S and P electronic states, was confirmed and the opposite polarisations of the outer components in the Q and PR type branches of such bands, verified. Another band (final state, 2P electronic state of the ortho-He_2 molecule; initial electronic state uncertain) gave relatively large effects throughout both Q and R branches (P branch too weak to observe), the polarisations being similar. A list is given of lines not yet allocated to bands, and showing large magnetic effects. W. S. S.

159. Arc Spectrum of Germanium. C. Richter. *Zeits. f. wiss. Phot.* 25. *pp.* 380–393, *Aug.*, 1928.

The arc spectrum of germanium was carefully measured from plates taken on a high dispersion instrument. The strong lines can be placed in a system of five fundamental terms which are exactly similar to those for silicon, lead and zinc. Satellites can be also observed in the case of the most intense lines. The Zeeman effect on a number of lines showed that they became triplets, and it was observed that these triplets were surrounded by uneven shadows probably due to an action of the satellites. No explanation for this division into triplets is offered. R. C. F.

160. Rotational Structure of the Blue-Green Bands of Na_2. F. W. Loomis and R. W. Wood. *Phys. Rev.* 32. *pp.* 223–236, *Aug.*, 1928.

Because of the theoretically impossible structure of these bands as reported by previous observers, the writers have measured them, in absorption, in the third order spectrum of a 7-in. plane grating mounted in a 40-ft. spectrograph. Each band is found, quite definitely, to consist of only one P, one Q and one R branch. This accords with Mulliken's theory that the electronic transition is $^1P - {}^1S$, and with the nature of the fluorescence series. Moreover, the absorption series correlate properly with the fluorescence series. The combination relations have been applied to all measured bands and found to hold, rigorously, within the experimental error, except for the expected PQR defect, which is very small. The more important constants of this band system are: $B_0'' = 0{\cdot}15431$, $I_0'' = 179{\cdot}5 \times 10^{-40}$ g. cm.^{2}, $r_0'' = 3{\cdot}08 \times 10^{-8}$ cm., $\alpha'' = 0{\cdot}0082$, $B_0' = 0{\cdot}12541$, $I_0' = 220{\cdot}9 \times 10^{-40}$ g. cm.^{2}, $r_0' = 3{\cdot}41 \times 10^{-8}$ cm., $\alpha' = 0{\cdot}00094$. These extremely large internuclear distances correspond to weak molecular binding, which is in accord with the low heat of dissociation previously reported. The locus of most intense vibrational transitions calculated from these constants and the previously reported vibrational constants, by the method of Franck and Condon, is found to be a good representation of the observed distribution. There is no evidence of alternating intensities. AUTHORS.

161. Energy Distribution in the Continuous Spectrum of the Aluminium Under-Water Spark. I. Wyneken. *Ann. d. Physik,* 86. 8. *pp.* 1071–1088, *Aug.* 4, 1928.

This is determined by the photographic-photometer method, comparing intensities with those of the carbon arc, since the under-water continuous spectrum extends over a wide region, within which the sensitiveness of the photographic plate varies greatly. There is a maximum at 2850 Å.U. corresponding to 3·5 times the energy at 4500 Å.U., and, if this is connected with temperature-radiation, means a temperature of 10,000° K. Comparison with the copper under-water spark does not suggest a dependence upon electrode-material. Absorption by the water does not account for the falling off in the curve towards the extreme ultra-violet. A. C. M.

162. Spectrum of Singly Ionised Carbon. A. Fowler and E. W. H. Selwyn. *Roy. Soc., Proc.* 120. *pp.* 312–326, *Sept.* 1, 1928.

In a previous paper it was shown that a considerable number of lines attributed to singly ionised carbon could be arranged in a regular system of doublet series involving transitions of a single electron [see Abstract 1473 (1924)]. These have here been revised and extended, and numerous lines are classified in the quartet system of Hund's theory. J. E.

163. Absorption by the Vapour of Excited Mercury and Reversal of the Green Ray and of its Satellites. M. Ponte. *Comptes Rendus,* 187. *pp.* 37–39, *July* 2, 1928.

For rays of different series, no relation exists between the intensity of rays emitted by excited mercury vapour and that of the absorption of the corresponding arc rays. The rays $^3P_{012}{}^3S$, $^3P_{012}{}^3D_{123}$, $2^1P_1 - m^1D_2$, and $2^1P_1 - m^3D_2$ are absorbed, the latter pair to a slight extent only. The PS series is more strongly absorbed than the PD series. In the absorption of PS, 2^3P_0 and 2^3P_2 are equivalent, and in that of PD, 2^3P_0 gives a strong absorption. Reversal of the rays is best studied by interposing excited mercury vapour between the plate and a cooled Cotton arc, and is observed for λ4358, for the green ray, and for six of its satellites, but not for the yellow rays. L. L. B.

164. Factors Governing the Appearance of the "Forbidden Line" 2656. R. W. Wood and E. Gaviola. *Phil. Mag.* 6. *pp.* 271–276, *Aug.*, 1928.

An investigation of the condition of the discharge tube in order that this "forbidden" line in optically excited vapour should be produced with maximum brightness relative to the pseudo-triplet 2652, 2654, 2655. Dry nitrogen or water vapour is found to increase brightness, while hydrogen diminishes it. Oxygen in the presence of water vapour destroys fluorescence, forming HgO which deposits on the walls of the tube. The condition for the appearance of the line is the presence of a large number of metastable mercury atoms. F. S.

165. Power Relation of the Intensities of the Lines in the Optical Excitation of Mercury. R. W. Wood and E. Gaviola. *Phil. Mag.* 6. *pp.* 352–356, *Aug.*, 1928.

It was found that the line 3650 of mercury behaved in an anomalous way. Its relative intensity with regard to 3654 or 3663 could be varied over a large range by changing the conditions of the excitation. The application of a magnetic field increased the intensities of all lines, but the line 3650 was increased sixteenfold in intensity. On further investigation of the relative intensities by the aid of a quartz spectrograph and a gauze screen to reduce the intensity of the arc, it was found that the intensities of all lines that appear in fluorescence are proportional to the arc intensity, with the exception of 3650 and 3021, that change with the third power, and of 2537 and 2656, that increase with the first power of the exciting light. An explanation of these changes is given. F. J. B.

166. Spark Spectra of Mercury Vapour. J. Valasek. *J.O.S.A. and R.S.I.* 17. *pp.* 102–106, *Aug.*, 1928.

Deals with the radiation potentials of the E_3 radiation as designated by L. and E. Bloch for part of the spark spectrum of mercury vapour obtained in an electrodeless discharge. Using a method previously developed by the author [see Abstract 2718 (1927)], two critical potentials, namely, 108 and 118 volts, were obtained for the E_3 radiation, and for some of the E_2 lines values of 47 and 55 volts were found. It is also concluded from the variation of the intensities of the lines with the current that when the atoms are multiply ionised it is usually by a single impact. R. C. F.

167. Ultra-Violet Bands of Mercury Hydride. H. Jeżewski. *Acad. Polonaise Sci. et Lettres, Bull.* 4–5*a. pp.* 143–162, *April–May*, 1928. *In French.*

A new set of bands emitted by a mixture of hydrogen and mercury vapour has been observed and measured between 2100 Å. and 2600 Å. The bands are analysed and the moments of inertia of the carriers found to be less than for those of the Hulthén bands. It is concluded that the carriers are the same in the two cases, but that the degree of excitation is greater. F. S.

168. Optical Measurements of Small Degrees of Dissociation of Vapours of Metallic Salts. I. Wyneken. *Zeits. f. phys. Chem.* 136. 1–2. *pp.* 146–158, *Aug.*, 1928.

The degree of dissociation of mercuric chloride vapour is determined by a photographic photometric comparison of the strength of the Hg absorption line 2536 in mercuric chloride vapour with the intensity of the same line in pure mercuric vapour under known pressure. The degree of dissociation at 200° C. is found to be $3 \cdot 10^{-4}$, this being in the neighbourhood of the value estimated according to the Nernst heat theory. J. K.

169. Absorption Band Spectrum of Cadmium Vapour. A. Jabłoński. *Acad. Polonaise Sci. et Lettres, Bull.* 4–5*a. pp.* 163–170, *April–May*, 1928. *In French.*

The absorption of the saturated vapour has been studied at temperatures from 580° C. to 1020° C., and thirty-four bands have been recorded, ranging from 2825 Å. to about 2590 Å., a number of these seem to coincide with fluorescent bands in the spectrum of CdII, though the first few of them seem to be related to those of CdI. When $\Delta\nu$ is plotted as a function of ν for short wave-length absorption bands the observed points do not lie on a very regular curve, but by extrapolating it is found that the point of convergence of the bands lies between 39,300 and 39,050 cm.$^{-1}$($\lambda = 2561$ Å.). This point of convergence has been shown, in a previous study of the excitation region of the resonance line $1'S - 2^3P_1$, to be connected with the dissociation of the Cd_2 molecule, and the activation to the 2^3P_1 state of one of the resulting atoms. Subtracting the energy of activation of the line $1'S - 2^3P_1$(3·7850 volts) from the energy corresponding to the above point of convergence (4·820 volts), the value 1·035 ± 0·031 volts is obtained for the energy of dissociation of Cd_2. If it is assumed that the system CdII is connected with dissociation, and the activation of an atom to the state 2^3P_0, the energy of dissociation would be $4{\cdot}741 - 3{\cdot}718 = 1{\cdot}023 \pm 0{\cdot}006$ volts. The two results agree remarkably well, and seem to confirm the interpretation of these systems given by the author. The enormous preponderance of continuous absorption in the vapour, as compared with band absorption, is considered theoretically, and various interesting conclusions are drawn.

H. N. A.

170. Series Spectra of Cadmium-like Atoms. J. B. Green and R. J. Lang. *Nat. Acad. Sci., Proc.* 14. *pp.* 706–710, *Sept.*, 1928.

The classification of spectra homologous with that of cadmium previously investigated by Green and Loring [see Abstract 641 (1928)] and Lamb is extended to SbIV. The lowest level is approximately 340,000 cm.$^{-1}$, corresponding to an ionisation potential of about 42 volts.

J. S. G. T.

171. Spectrum of Sulphur, SII. S. B. Ingram. *Phys. Rev.* 32. *pp.* 172–178, *Aug.*, 1928.

The spectrum was excited by passing a condensed discharge through H_2S gas and then adjusting the self-induction in the circuit. Photographs were taken with a 7-m. grating, with a quartz spectrograph and with a 1-m. grating *in vacuo*. One hundred and eighty-three lines of SII are classified. Thirty-three lines of the quartet and thirty-six of the doublet system are determined and correlated with the electron configurations by means of Hund's theory. The ionisation potential of the SII ion is fixed at 23·3 ± 0·1 volts.

F. S.

172. Regularities in the Spark Spectrum of Hafnium. W. F. Meggers and B. F. Scribner. *J.O.S.A. and R.S.I.* 17. *pp.* 83–90, *Aug.*, 1928.

In this paper the authors describe the present position of their analysis of the ionised hafnium atom spectrum (HfII) made from arc and spark spectra photographed with large dispersion spectrographs. Owing to the lack of details regarding Zeeman effects, temperature classification of spectral lines and similar descriptive information the classification has been performed using the combination principle as a criterion. Inner quantum numbers have also been assigned to the energy levels. A careful selection of spark lines which also appeared with high intensities in the arc were assumed to involve low energy states of ionised atoms and several energy levels obtained from them. These served as a nucleus of a significant wave-number system which was finally developed into a two-dimensional matrix. A table representing this matrix is given in

which there are 16 levels together with derived values for 27 higher states, and the total number of lines classified is 206. By analogy with the TiII and ZrII spectra it may be anticipated that the spectral terms of HfII will belong to a doublet and quartet system with 33 levels, thus indicating that this analysis, with only 16 levels, is still incomplete.
R. C. F.

173. Arc and Spark Spectra of Hafnium. W. F. Meggers. *Bureau of Standards, Dept. of Commerce, Research Paper No.* 8. *pp.* 151–187, 1928.

Using the purest available samples of Hafnium salts, the arc and spark spectra have been photographed with concave-grating and quartz-prism spectrographs. Tables are given of nearly 1500 lines extending from 2155·72 Å. to 9250·27 Å., and a comparison is made with the results of Hansen and Werner [see Abstract 268 (1924)]. A precision of 0·01 Å. is claimed as well as a more critical differentiation between the lines of HfI and HfII. The most sensitive lines of both spectra are tentatively selected, and some of the stronger HfII lines identified with faint Fraunhofer lines.
F. S.

174. Spark Spectrum of Silver. J. C. McLennan and A. B. McLay. *Roy. Soc. Canada, Trans.* 22. *Sect.* 3. *pp.* 1–13, *Jan.*, 1928.

The values given by Beals [see Abstract 382 (1927)] have been analysed in accordance with the term structure predicted by Hund's theory. Tables of term values are given in which a comparison is made with corresponding spectra.
F. S.

175. Resonance Spectrum of Selenium. Barbara Schmidt. *Acad. Polonaise Sci. et Lettres, Bull.* 3*a. pp.* 61–68, *March,* 1928. *In French.*

The selenium was vaporised in a quartz tube by heating to various temperatures up to 500° C. The resonance excited by the 4481 Å. line of Mg was photographed in 150 hours and the spectrogram measured with a Moll microphotometer. The lines can be expressed by the formula $1/\lambda = 22312 - 362\,m + 1{\cdot}3\,m^2$, and a table of values is given in which the majority of the lines are " anti-Stokes " lines. The greatest intensity was observed at 400° C., and the absorption of 4481 Å. corresponds to a passage from state $n = 14$ to $n' = 1$. The results are in agreement with those of Ehrenfeucht and of Rosen [see Abstract 2536 (1927)].
F. S.

176. Method of Horizontal Comparison in the Location of Spectra of Elements. M. Saha and K. Majumdar. *Indian Journ. Phys.* 3. *pp.* 67–76, *Sept.* 30, 1928.

Explains a fairly successful method of locating the spectrum of an element from a given group when the spectra of two or more elements of the group are known. Considering the successive elements B, C, N, O, F, Ne and Na, the K and L_1 rings are complete, the L_2 orbit in the normal state varies from 1 to 6 from B to Ne, and for Na there is one electron in the M_1 orbit besides the 6 in L_2. Further, C^+, N^+, . . . Na^+, Mg^+, and N^{++}, O^{++}, . . . Mg^{++}, Al^{++} have the same electronic configurations as B, C, . . . Na respectively. A comparison of the corresponding lines of these groups, by considering the transition $xL_2(M_1 \leftarrow M_2)$ and choosing lines which arise from the highest multiplicity, leads to the conclusion that the frequencies of the lines chosen for the elements in each group increase linearly with the atomic number, except for $x = 0$. In a similar manner, lines of the elements Al, Si, P, S, Cl, A and K are compared, and again the same conclusion is reached. Thus the location of spectra of elements, in such a group as has been considered, can be readily made. This method is of special importance in cases where the irregular doublet law is not applicable owing to lack of data. R. C. F.

177. X-Ray Diffraction and its Bearing on Molecular Complexity in the Liquid State. P. Krishnamurti. *Indian Journ. Phys.* 2. *pp.* 491–500, *July* 31, 1928. *In English.*

The X-ray diffraction patterns of a number of organic liquids have been investigated, and it is shown that those liquids which the Ramsay-Shields equation indicates to be associated have a very prominent inner ring. Further, by substituting the value of the spacing obtained from X-ray measurements for $\sqrt[3]{m/d}$ in the above equation, certain anomalies disappear. Liquids containing polar groups are most associated. Fatty acids give an association factor of approximately two. The results also show that benzene and hexane are slightly associated. F. J. W.

178. X-Ray Diffraction in Solutions and Liquid Mixtures. Part I. P. Krishnamurti. *Indian Journ. Phys.* 2. *pp.* 501–507, *July* 31, 1928. *In English.*

X-ray diffraction patterns of powdered ammonium nitrate and acetamide show two rings which persist with some slight contraction in patterns obtained from the same substances in the liquid state or concentrated aqueous solution. This result indicates the existence of a regular space array in concentrated aqueous solution. Progressive dilution is accompanied by a contraction and diminution in intensity of the inner ring, while the outer ring expands and finally merges into the water ring. F. J. W.

179. X-Ray Diffraction in Liquids. Isomers of Normal Heptane. G. W. Stewart. *Phys. Rev.* 32. *pp.* 153–161, *Aug.*, 1928.

This is a continuation of previous work [see Abstract 941 (1928)]. The diffraction peak for synthetic hexane occurs at the same angle as for paraffins with five to fifteen carbon atoms, so that the diameter of the normal paraffin chain in this range is 4·64 Å. The length of chain is in agreement with the formula $L = (1\cdot 24\, n + 2\cdot 70) \times 10^{-8}$ cm. if n is the number of carbon atoms, and if molecules may be regarded as longitudinally parallel and in square array in the plane normal to their lengths. The agreement is closer than 1 %. Six heptane isomers are found to have diameters 1·04 Å. larger than the normal paraffins. A number of conclusions are reached regarding alterations due to the addition of a CH_3 group. F. S.

180. Laue-Photograph taken with Convergent X-Rays. T. Fujiwara. *Kyoto Coll. Sci., Mem.* 11. *pp.* 283–301, *July*, 1928. *In English.*

A method is described for determining the orientation of the crystals in tungsten wire. Laue photographs are taken with the convergent X-rays starting from the focus of the molybdenum target of a Coolidge tube. The Laue spots so obtained are sometimes accompanied by the spectrum lines of the K-radiation of molybdenum. From the relative positions of the intense nucleus at the centre of the spots and the spectrum lines it is possible to determine the orientation of the crystal. F. J. W.

181. New Method of X-Ray Spectrography with Applications to the Study of the Orientation of the Molecules of Fatty Acids by Mercury Surfaces. J. J. Trillat. *Comptes Rendus,* 187. *pp.* 168–169, *July* 17, 1928.

The method uses the natural curvature of a film of fatty acid—melted by heating where necessary—formed on the surface of a pellet of mercury: the effect is that of a curved crystal surface. Intense photographs of X-ray diffraction patterns are obtained with relatively short exposures. Details are not given, but the general summary of the results indicates that the method is of distinct promise in the investigation of organic liquids and solids, and of interfacial phenomena. H. R. R.

182. X-Ray Spectroscopic Observations on Cellulose. Part IV. R. O. Herzog and W. Jancke. *Zeits. f. Phys.* 49. 1–2. *pp.* 27–30, 1928.

The interference patterns obtained from cellulose [see Abstract 2788 (1924)] have been shown to depend only on the experimental arrangements such as the inhomogeneity of the rays, and bear no relation to the structure of the cellulose. F. J. W.

183. Statistical Calculation of the M-Röntgen Terms. F. Rasetti. *Zeits. f. Phys.* 49. 7–8. *pp.* 546–549, 1928.

Calculates the energies of the quantum conditions of the electrons in an atom on Fermi's theory of gaseous degeneration, with special reference to the M-Röntgen terms. The values found agree well with the empirical values. E. E. F. d'A.

184. $K\beta_2$ Lines of the Elements K to Mn. T. Wetterblad. *Zeits. f. Phys.* 49. 9–10. *pp.* 670–673, 1928.

New measurements of the wave-length difference $K(\beta_1 - \beta_2)$ for the elements 19 K to 25 Mn are submitted. (1) The irregularity observed by Bäcklin, Siegbahn and Thoraeus for K and Ca is confirmed. (2) The wave-length of the β_2 line is shown to depend on the state of chemical combination. (3) The satellite β^{III} measured by Druyvesteyn is occasionally found doubled for K and Ca. W. S. S.

185. X-Ray Spectroscopic Measurements of the M-Series of the Elements Uranium to Gadolinium. E. Lindberg. *Zeits. f. Phys.* 50. 1–2. *pp.* 82–96, 1928.

A systematic investigation of the M-series of the elements Uranium to Gadolinium has been carried out using a Siegbahn vacuum spectrograph. Using a fine slit, a large number of new lines have been measured, chief among which are $M_{\text{III}}O_{\text{V}}$, $M_{\text{III}}N_{\text{IV}}$, $M_{\text{IV}}N_{\text{III}}$ and $M_{\text{IV}}N_{\text{II}}$. The work of Tuuk [see Abstract 116 (1928)] on the multiplet character of the Röntgen doublet $M_{\alpha_1, \alpha_2, \beta}$ is confirmed for the range of elements investigated. Intensity measurements qualitatively support the intensity rule. F. J. W.

186. Weakening of X-Rays by Passage through Various Substances. H. Stumpen. *Zeits f. Phys.* 50. 3–4. *pp.* 215–227, 1928.

The weakening coefficient (defined here as the total weakening experienced by a beam of X-rays in passing through a material substance in consequence of true absorption and scattering) is measured for water, Cu, Al, Ag, toluol, xylol, oleic acid, palmitic acid, and stearic acid, by the Bragg spectrometer method, using two ionisation chambers (one screened off) to balance out leakage currents. The present communication consists of results only; discussion is deferred. **Supplementary Note,** *ibid.*, 52. 1–2. *p*. 150, 1928. A. C. M.

187. Secondary Normals of Röntgen Wave-Lengths. M. Siegbahn. *Zeits. f. Phys.* 50. 7–8. *pp*. 443–447, 1928.

The author refers to the values obtained by H. Iwata for the wave-length of Mo · Kα_1 [see Abstract 2737 (1928)] by the wedge and crystal methods, and compares these with the values found by Leide, Larsson and Allison and Armstrong. He considers that larger accidental errors occurred in Iwata's experiments than in those of the others, all of whose values are lower than Iwata's. The possible sources of these differences and the advantages of obtaining relative measurements of wave-lengths in terms of one or more standards, rather than independent absolute values, are discussed. R. S. R.

188. K-Absorption Spectra of Different Potassium Salts. O. Stelling. *Zeits. f. Phys.* 50. 9–10. *pp*. 626–629, 1928.

The author gives the results for the K-absorption limits of a large number of potassium salts, thereby completing Lindh's work, the influence of the size of the anions also being considered. It is shown that Lindh's suggestion of a division into three groups does not hold, and there is also a range of from 3425·5–3427·9 X.U. in the values of the absorption limit. In certain cases the acid and the neutral salts of the same acid give different absorption limits for potassium, although the phenomenon is not general. R. C. F.

189. L and M X-Rays of Rhenium. H. Beuthe. *Zeits. f. Phys.* 50. 11–12. *pp*. 762–768, 1928. *From the Reichsanstalt.*

The weaker lines in the L-series of rhenium, the L-absorption constants, and the strongest lines of the M-series are measured relatively, and the corresponding term-values are calculated. A. C. M.

190. Compton Effect and Polarisation. P. Lukirsky. *Nature,* 122. *pp*. 275–276, *Aug*. 25, 1928.

In the case of hard X-rays ($\lambda = 0{\cdot}07$ Å. to $0{\cdot}1$ Å.) the secondary radiation scattered from light substances consists almost entirely of rays with increased wave-length (in consequence of the Compton effect). The scattered (modified) rays are polarised in the same manner as they should be in the case of classical scattering. The same may be said of the special distribution of the intensity of scattered rays. W. V. M.

191. X-Ray Camera for High-Temperature Work. W. M. Cohn. *Zeits. f. Phys.* 50. 1–2. *pp*. 123–136, 1928.

An illustrated description of a furnace suitable for taking X-ray powder photographs at high temperatures. Typical photographs of pentraerythetol are given, and quartz was also studied. W. H. Ge.

192. Theory of the Double X-Ray Spectrometer. M. M. Schwarzschild. *Phys. Rev.* 32. *pp*. 162–171, *Aug*., 1928.

The geometrical factors in the construction and use of the double X-ray spectrometer used by Davis and Purks [see Abstract 1299 (1928)] are examined in detail. It is found that the resolution of the instrument is not affected by the width of the slits, but that the height of the slits must be limited to preserve resolution. The physical factors—crystal imperfection, line width, diffuseness of absorption limits—are also discussed, and formulæ are derived by means of which experimental curves may be interpreted physically. F. S.

193. Vacuum Grating Spectrograph for Ultra-Violet and Soft X-Rays. J. Thibaud. *J.O.S.A. and R.S.I.* 17. *pp.* 145–154, *Aug.*, 1928.

Contains an account of the latest design of the author's vacuum spectrograph, with reproductions of photographs of X-ray and extreme ultraviolet spectra taken with the instrument. It is shown that Kossel's hypothesis, that the Moseley line goes upwards when a level becomes a valency level, is justified for elements below neon; some other results with regard to the low-frequency levels are given. The author has been able to record a continuous spectrum from elements of high atomic weight, divided by a succession of fine bands with abrupt edges on the short wave-length side. These are due to absorption by elements in the path of the X-rays; carbon (vapour from grease used in joints), nitrogen and oxygen exist in the vacuum space, and the intense K band of carbon in five orders has been observed in the photographs, also those of N and O. The wave-lengths of these K edges are in good accordance with Holweck's results, using the ionisation method. The final paragraph deals with the refractive index for soft X-rays; it is shown that when the refractive index is taken into account the discrepancy disappears between results obtained with the grating spectrograph and by Dauvillier's method, using the rotating crystal method with stratified coats of fatty acids having very long spacing. H. N. A.

194. Photoelectric Effect of Soft X-Rays. G. B. Bandopadhyaya. *Roy. Soc., Proc.* 120. *pp.* 46–58, *Aug.* 1, 1928.

Soft X-rays from a copper plate fell on photoelectric plates of C, Al, Fe, Co, Ni, Cu, Ag, Mo, W, Pt, Au, Ta, voltages of 500, 400, 300 and 200 being employed between the heated tungsten filament, which formed the kathode, and the copper anti-kathode. The ratio between the photoelectric and the thermionic currents, i_p/i_t, was determined in each case, first with the photoelectric plates thoroughly degassed and then without degassing, the latter values are the higher except for aluminium, i_p/i_t, the photoelectric efficiency of the degassed metals was plotted against the atomic numbers of the metals used, but no simple relationship appeared. The relative sensitivities are not far from those observed with ultraviolet light. It is shown that theoretically the number of photoelectrons liberated should be proportional to the voltage of the X-ray tube, which is found to be approximately true. It is probable that most of the photoelectrons come from the outer valency orbits. H. N. A.

195. Investigation of Physical Purity by the X-Ray Powder Method. N. H. Kolkmeijer. *Zeits. f. phys. Chem.* 136. 1–2. *pp.* 45–48, *Aug.*, 1928.

The possibility of drawing false conclusions from X-ray data is discussed. The fact that Levi found that yellow and red mercuric oxide gave identical X-ray diagrams does not necessarily establish the crystalline identity of the two forms, unless it can be proved that the samples analysed were "physically pure." As a test of physical purity, the agreement between the values for the density as determined with the pyknometer and from X-ray data is suggested. This criterion is shown to be valid in the case of grey and white tin. L. L. B.

RADIOACTIVITY.

196. Number of Ions Produced by the α-Particles of Radium-C′ in Air. Irène Curie and F. Joliot. *Comptes Rendus*, 187. *pp.* 43–44, *July* 2, 1928.

By means of the apparatus previously described by the authors [see Abstract 3258 (1928)] for measuring the ionisation due to a known fraction of the total radiation of the source, a final corrected value of 1944 ± 10 e.s.u. is obtained for the ionisation current produced in the angle 2π by the α-particles emitted from 1 millicurie of radium-C′. Taking the number of α-particles emitted by 1 gm. of radium to be $3{\cdot}70$ or $3{\cdot}45 \times 10^{10}$, the values $2{\cdot}20$ or $2{\cdot}36 \times 10^5$, respectively, are found for the number of ions produced by one α-particle from radium-C′. The second result differs considerably from that deduced from Geiger's number if the old value for the charge, $4{\cdot}65 \times 10^{-10}$ e.s.u., is replaced by $4{\cdot}774 \times 10^{-10}$ e.s.u. Exact proportionality of ionisation to energy is not obtained for the radiations of radium-C′. L. L. B.

197. Radium Emanation Content of the Atmosphere as Determined by Aeroplane Observations. A. Wigand and F. Wenk. *Ann. d. Physik*, 86. 5. *pp.* 657–686, *July* 28, 1928.

Stresses the need for more direct determinations of the variation with height of the concentration of Ra emanation in the atmosphere. Aeroplane observations were considered to be the only type suitable for quantitative work, and condensation by liquid oxygen was found to be the only reliable method of collecting the emanation. Full details are given of the apparatus, which had to be specially designed to meet the exceptional experimental conditions. The time required for the collection of emanation is 3–7 min., and the apparatus is capable of taking up to three samples during a single flight. The samples are landed and tested by the emanation electroscope. All the flights recorded were made in the vicinity of Berlin, and the samples tested in Halle. Meteorological conditions and other details of the flight are fully tabulated in each case. The general results of the measurements show a marked diminution of emanation content with increasing height. Within the limited range of the measurements, observed variations can be explained in terms of air currents prevailing at the time of, and immediately preceding, the observations. The evidence definitely supports the view that the emanation in the atmosphere comes solely from terrestrial sources. Results are also tabulated of "ground" observations made in and near the Physical Laboratory in Halle. Particularly high values are obtained on the tower of the laboratory, 30 metres high. These are attributed to possible effects of emanation occluded by colloidal soot and dust particles in the town atmosphere—with possibly additional emanation released from burning fuel. H. R. R.

198. High Altitude Radiations, Absorption in Lead, Secondary Radiations and Wave-Length. L. Myssowsky and L. Tuwim. *Zeits. f. Phys.* 50. 3–4. *pp.* 273–292, 1928.

The absorption in lead has been investigated under experimental conditions which were very similar to those employed in the case of water. The primary cosmic rays are absorbed in lead, as in water, owing to scattering, without any marked photoeffect; the coefficient of absorption in lead agrees with that calculated from the value obtained previously with water. A closer investigation of the upper part of the absorption curve (small thicknesses of lead) was carried out, using a monolith of ice measuring $200 \times 202 \times 203$ cm.^{3} with a cavity in the interior in which the electroscope was placed; the absorbing layer of lead was placed either on the top of the monolith or in the interior above the electroscope. It was found that the sharp drop in the absorption curve near the boundary between the lead and ice or air is due to scattered radiation, similar to γ-rays, coming from above; when this is absorbed in lead there is a considerable photoeffect. The results obtained show that the method of calculating the wave-length of the high altitude radiation on the assumption that the coefficient of absorption is the same as the coefficient of scattering is justified. H. N. A.

199. Attempts to Detect Transmutation of Elements by Kathode Rays. A. Koenig and F. v. Körösy. *Zeits. f. Elektrochem.* 34. *pp.* 305–311, *June,* 1928.

The experiments already referred to [see Abstract 674 (1928)] are described in greater detail. T. H. P.

200. Atomic Syntheses which are Manifested in Connection with Atomic Disruption and the Theory of the Building of Atoms from Hydrogen and Helium. W. D. Harkins. *Zeits. f. Phys.* 50. 1–2. *pp.* 97–122, 1928.

The experiments previously described [see Abstract 2085 (1927)] are detailed and their results discussed in relation to the author's theory of the constitution of atomic nuclei. F. J. W.

201. γ-Ray Spectrum of Protoactinium and the Energy of γ-Rays Emitted During α- and β-Ray Transformations. (Miss) L. Meitner. *Zeits. f. Phys.* 50. 1–2. *pp.* 15–23, 1928.

The β-radiation of protoactinium was analysed in a magnet field, and of the twelve β-ray groups found nine were shown to be related to three γ-ray lines from the nucleus, with the wave-lengths 130, $41{\cdot}9$ and $38{\cdot}2 \times 10^{-11}$ cm. When the γ-ray spectra of the different radioactive elements are compared it is seen that the energy given out in the form of γ-rays (shortest wave-length γ-line) is of the same order of magnitude for all α-radiators, while in the case of β-radiators it varies by more than the ratio 1 : 50. This means that the rearrangement of the residual nucleus after disintegration, as far as it takes place with emission of γ-rays, is carried out in the case of α-radiators with energy outputs of the same order of magnitude, while for the β-radiators the energy outputs vary in the ratio of 1 : 50. This behaviour shows a certain parallelism with the relative energies of the emitted α-rays and primary β-rays. With α-radiators in the same disintegration series the energy of the shortest wave-length γ-line emitted is larger the greater the life of the element, while with β-radiators the reverse is the case. Some results of these facts are discussed. H. N. A.

202. Condensation of Water Vapour on Charged Atoms of Actinium A. M. Akiyama. *Comptes Rendus*, 187. *pp*. 341–342, *Aug*. 6, 1928.

A photographic method was employed, and by regulating the interval between expansion and photography all the products of expansion can be made visible. The disintegrated atoms of actinium were found to be mobile in an electric field until they were surrounded by a supersaturated atmosphere of water vapour. For a vertical fall of 0·026 cm. the life of the actinium atom was 0·00047 sec. with a mobility of 1·56 cm. in a field of 1 volt/cm. Under certain assumptions regarding the number of atoms formed and acting as centres of condensation, it is shown that approximately half of the recoil atoms do not act as centres of condensation. On the other hand, the number of atoms formed and their life agree with radioactive data. Hydrogen gives similar results. The results can be explained by assuming that the charged recoil atoms do not act as centres of condensation like positive ions, while they do so act with a higher degree of supersaturation. There is in the latter case no contradiction of Dee's results. R. S. R.

203. Mode of Action of the Geiger Point Counter. H. Geiger and O. Klemperer. *Zeits. f. Phys*. 49. 11–12. *pp*. 753–760, 1928.

Distinguishes between the multiplication effect, which is observed when the case of the counter has a negative voltage which does not exceed a certain value, and the effect produced at higher voltages, when every entering ray produces a rush of current which is more or less independent of the number of primary ions produced by the ray. It is shown that it is necessary to work in the former region if α-rays are to be registered, and not β-rays. The ionisation produced by the former is nearly a thousand times that from the latter and when the deflections are nearly proportional to the ionisation as is the case with the multiplication effect, the β-rays produce practically no deflection. The form of the "point" most suitable for α-ray determinations was investigated, also the relation between the sensitiveness and the direction and excentricity of the rays entering the counter. The investigation is of importance in defining the conditions required when the counter is used in observations on the artificial disintegration of atoms and on the scattering of α-rays. H. N. A.

204. New Method for Counting Corpuscular Rays using Purely Electronic Amplification. E. Ramelet. *Ann. d. Physik*, 86. 6. *pp*. 871–913, *Aug*. 4, 1928.

The Greinacher method of ray counting [see Abstract 1379 (1926)] was subjected to a critical investigation. It was found that to obtain deflections in the final galvanometer proportional to the primary ionisation, resistance amplification was preferable to low-frequency transformer amplification. The total amplification attained (referred to charge) equalled $1{\cdot}65 . 10^9$, and under controlled conditions remained constant. The different deflections given by α-particles under apparently identical conditions were traced to fluctuations in the amount of the primary ionisation. Statistical frequency curves for the recorded deflections of large numbers of α-particles were constructed for different gases in the ionisation chamber. Simple gases (O_2, N_2) gave frequency curves of less dispersion than mixtures or chemical compounds (air, $H_2 + N_2$, CO_2). Monatomic gases were not investigated. W. S. S.

HEAT.

205. Thermal Conductance in Non-Metals and Metals. A. Eucken. *Phys. Zeits.* 29. *pp.* 563–566, *Aug.* 15, 1928. *Abstract.*

Non-metallic crystals are good conductors of heat, and their conductivity improves on cooling; amorphous substances are poor conductors and become worse on cooling. According to Debye, the solid is a system of coupled resonators in which several long wave oscillations are superposed upon the atomic and molecular oscillations. These resonance waves can develop properly only in crystals, not in amorphous substances of random molecular arrangement. These waves are not purely harmonic, and are disturbed by the heat movement itself. The range l of these waves is given by $\lambda = \frac{1}{4} \rho l w_s c_v$, where ρ is the density of the substance and w_s the mean rate at which the waves are spreading. Such an energy transfer by trains of waves is conceivable on Broglie's views. The author discusses from this point of view the λ of single crystals (*e.g.*, calcspar) and of crystalline aggregates (*e.g.*, marble, natural or artificial compressed powders of the same or different salts). The λ increases with increasing hardness, and its temperature coefficient is low in mixed crystals.

In the case of metals the law of Wiedemann-Franz: $\lambda/\sigma T = L_m$, where σ is the electric conductivity and L_m = constant = $2 \cdot 44 \times 10^{-8}$ watt-second-ohm per deg.^{2} (Sommerfeld), was supposed to hold, and it was assumed that the λ depended upon the electrons, not upon the atomic lattice. The author suggests $\lambda = \lambda_i + \lambda_m$, λ_i being due to the thermoelastic waves, λ_m to the electrons, and shows by the data of Grüneisen and Goens that L_m is not constant in the sense of Sommerfeld [see Abstract 1368 (1928)]. H. B.

206. Simple Relation between Thermal Conductivity, Specific Heat and Absolute Temperature. C. C. Bidwell. *Phys. Rev.* 32. *pp.* 311–314, *Aug.*, 1928.

A relation of the form $k/aC = K_1/T + K_2$, between thermal conductivity k, atomic heat (aC), and absolute temperature T, is shown to hold for zinc, sodium, lithium, copper, lead, aluminium and mercury. The possibility is indicated of an equation of this sort based on the assumption of a double mechanism of heat conduction—an atomic lattice along which energy is transmitted as elastic waves (Debye) and a structure of atoms (crystalline or amorphous), through which energy is transferred by impacts. The lattice and atomic contributions to the thermal conductivity may be obtained from the slopes and intercepts of the lines. The values at 0° C. are as follows (lattice part being given first): lithium 0·150, 0·006; sodium 0·092, 0·169; zinc 0·084, 0·192; copper 0·920, 0·171; lead 0·018, 0·068; aluminium 0·127, 0·358; mercury 0·031, 0·033. The line for mercury suggests that the atomic part is at least approximately the conductivity in the liquid state. The single and poly-crystal zinc lines have the same intercept but different slopes, indicating that the increased thermal conductivity of the single crystal specimen is in the elastic wave contribution. AUTHOR.

207. Steady Flow of Heat in a Rectangular Parallelepiped. E. W. Chivers. *Phil. Mag.* 6. *pp.* 305–309, *Aug.*, 1928.

A solution is given of the problem of the flow of heat in a rectangular prism heated at the top surface, and cooled at the lower surface, the other faces radiating heat to the surrounding air kept at the temperature of the lower surface. Accepting Carslaw's proof that the temperature may be expressed as a Fourier series, the equations obtained can be conveniently solved by obtaining an approximate solution by means of a graph, and then solving more accurately by " trial and error." An example is given for a specimen of granite, the method being used in the determination of the thermal conductivity of rocks. T. B.

208. Influence of Molecular Forces of Attraction on the Internal Friction and Heat Conductivity of Gaseous Mixtures. H. Schmick. *Phys. Zeits.* 29. *pp.* 633–640, *Sept.* 15, 1928.

A previous paper by the author and H. Gruss on the measurement of the heat conductivity of gaseous mixtures at atmospheric pressure and over a temperature range of 20° to 80° C. showed that there were considerable discrepancies from the simple mixture rule. The forces working between dipolar and quadripolar structures in gaseous mixtures were examined and their influence on the gas kinetic impulse amount investigated. The results of the calculations led to the study of related conditions, *e.g.*, the internal friction of gaseous mixtures, and the whole treatment is outlined in the present paper. The conditions are examined for a large number of gaseous mixtures, including air/ether, air/acetylene, CO/NH_3, etc. It is shown that a maximum can only occur when the conductivity, or the internal friction respectively, of the components of the mixture are approximately equal, as, *e.g.*, in the case of air/acetylene. The maximum is not characteristic as such, but the variation from the simple mixture rule can be defined by the expression $L/(p_1L_1 + p_2L_2)$. Finally, it can be said that the differentiation between homopolar and heteropolar molecules causes a discrepancy from the simple mixture rule of a maximum value of 7 %. There are, of course, intermediate values between this and the ideal case. S. G. B.

209. Determination of the Heat of Expansion of Air Sensitive Crystalline Salts. W. Klemm. *Zeits. f. Elektrochem.* 34. *pp.* 523–528; *Disc.*, 528, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

An investigation based on crystal lattice work. Tables are given comparing the cubical coefficients of expansion for the halogen derivatives of the main groups of the periodic classification of the elements, as well as for the sub-groups. Among the other data given are tables showing the relationship between the molecular volume of the salts in the solid and melted condition. J. K.

210. Method of Determining the Absolute Zero of Temperature. J. R. Cotter. *Phil. Mag.* 6. *pp.* 318–320, *Aug.*, 1928.

Kelvin has suggested that the thermodynamic scale might be realised by means of a vapour-pressure thermometer containing a mixture of water and steam. The author suggests a method, based on Kelvin's proposal and the use of electrical calorimetry, for finding the position of the absolute zero of temperature with a great degree of precision. Making use of Clapeyron's equation $dT/T = (v_2 - v_1)dp/Q$, a sketch is given of an apparatus for measuring v_1 and v_2, and of finding Q as a function of p at temperatures ranging from the freezing point T_0 to the boiling point T_{100}. With the instrument suggested it is claimed that the whole thermodynamic scale down to the lowest temperatures could be reconstructed by using a succession of suitable liquids, though some modification would be necessary below the freezing point of mercury. T. B.

211. Majorana's Residual Thermic Effect. Marie Anna Schirmann. *Phys. Zeits.* 29. *pp.* 676–678, *Sept.* 15, 1928.

Majorana's residual thermic effect in steel, iron, lead and copper (*Accad. Lincei, Atti*, 4. *p.* 419, 1926) is considered. Two unequally heated pieces of the same metal take weeks to cool down to the same temperature in a thermometer. The author attributes this to the continuous sorption by the cooling metal of gases to replace those which it had parted with when heated up. A. D.

212. Experiments on a Ferromagnetic Compound of Manganese and Arsenic. L. F. Bates. *Phil. Mag.* 6. *pp.* 593–597, *Sept.*, 1928.

In a previous investigation [see Abstract 1327 (1928)] the author found that the specific heat of a ferromagnetic substance consisting of equal parts of manganese and arsenic rose from 0·12 at 28° to about 0·14 at 36° C., thence with increasing rapidity to 1·0 at 42° C., and then fell rapidly to 0·13 at 45°. Also the rate of decrease of the intensity of magnetisation with rise in temperature was found to be a maximum at 42·2° C., whereas dI^2/dT was a maximum at 41·5° C. Experiments are now described which show the behaviour of the potential difference between the above substance and a solution containing a manganese ion. Pronounced changes occur as the substance passes through its magnetic critical temperature and a theoretical discussion is given. The experiments of Sucksmith and Potter [see Abstract 158 (1927)] show that the specific heat may behave in a very different manner from that predicted by the Weiss theory. H. H. Ho.

213. Thermal and Magnetic Investigations on Absorbed Gases. F. Simon. *Zeits. f. Elektrochem.* 34. *pp.* 528–530; *Disc.*, 530–531; *Sept.*, 1928. *Paper read before the Deut. Bunsen. Gesell., Munich, May*, 1928.

Specific heat determinations seem to indicate that an absorbed gas—as, for example, hydrogen in iron—behaves as a free gas. Lowest temperatures possible were used. The specific heat of iron is measured between 6° to 12° absolute. J. K.

214. Limiting Values of the Latent Heat of Evaporation and Specific Heat of Saturated Vapour at Absolute Zero. N. v. Kolossowsky. *Zeits. f. phys. Chem.* 136. 5. *pp.* 314–316, *Sept.*, 1928.

The author states that thermodynamics does not allow us to say anything about the limiting values of the latent heat, of the entropy Sg of a gas and the specific heat Cg of a saturated vapour at absolute zero. He then gives the fundamental thermodynamical equations, and, with the assumption that the entropy of the liquid $Sl = O$ and that $C'l = Cpl$, where Cpl denotes the specific heat of the liquid at constant pressure, he finds at absolute zero that

$$\lim_{T=0} Sg = \lim_{T=0} \frac{h}{T} = \lim_{T=0} (Crg - C'g) = AR \,.\, \lim_{T=0}\left(T\frac{dlnp}{dT}\right).$$

To get any further either some additional hypothesis must be made or recourse must be had to experimental evidence. He then criticises the deductions and arbitrary assumptions made by Verschaffelt [*J. Chim. Phys.* 23. 240, 1926, and 25. 408, 1928] and J. J. van Laar [*J. Chim. Phys.* 24. 119, 1927] in attempting to find the limiting values, which the author considers entirely incorrect. T. B.

215. Dibenzyl Ether as a Cryoscopic Solvent. G. M. Bennett and G. H. Willis. *Chem. Soc., J. pp.* 2305–2307, *Sept.*, 1928.

The mean value of the cryoscopic constant K with different solutes was found to be 62·7; this makes the latent heat of fusion of dibenzyl ether 24·4 cals. per gm. A few cryoscopic observations were also made with benzoic and acetic acids, and benzyl alcohol as solutes, benzene and dibenzyl either being employed as solvents; a table gives the apparent molecular weights (M) of the hydroxylic substances, the values are definitely lower in dibenzyl either than in benzene, but there is not much difference in the case of benzyl alcohol in the two solvents. H. N. A.

216. Precise Determination of Thermal Capacities, with Particular Reference to that of Molybdenum. T. E. Stern. *Phys. Rev.* 32. *pp.* 298–301, *Aug.*, 1928.

It was found that a Bunsen ice calorimeter modified by the addition of a silvered vacuum jacket was capable of yielding precise values of the total heats of substances. The falling body was contained in a metal capsule to eliminate errors due to radiation and convection during fall. Thermal contact was established in the calorimeter by a copper cup, containing water or mercury, and surrounded by water. The probable error of a single observation of the motion of the mercury thread caused by a hot body was about one part in one thousand. By this method the specific heat of molybdenum was found to be $c_p = \cdot 05973 + \cdot 00001619t$ mean cal./gm. °C. between the temperatures of 0° C. and 444·5° C. AUTHOR.

217. Heat Capacities of Organic Compounds at Low Temperatures. Part I. A Precision Calorimeter and Thermostat for Low Temperatures. D. H. Andrews. *Frank Inst., J.* 206. *pp.* 285–299, *Sept.*, 1928.

A description of the construction, experimental details and accuracy of working of a precision calorimeter and thermostat for measuring the specific heat of organic compounds at temperatures from − 200° C. to room-temperature. The work is being undertaken to verify the work of Einstein, Debye and others on the movements of atoms in the crystal lattice. The apparatus is specially designed to be used with substances of low thermal conductivity, substances which are corrosive and also substances of which only small amounts are available. Full constructional details are given, and an actual example of use given in the case of *n*-heptaldehyde. The author proposes to make temperature measurements with the apparatus accurate to about 0·002 °C. S. G. B.

218. Effects of Certain Corrections on the Heats of Combustion of Organic Compounds. W. Swietoslawski and (Miss) H. Starczewska. *Acad. Polonaise Sci. et Lettres, Bull.* 3A. *pp.* 85–97, *March*, 1928.

The authors continue their investigation of the corrections necessary to ensure strict comparability in thermochemical data [see Swietoslawski, *J. Chim. Phys.* 22. 391, 1925], and here deal with corrections necessitated by combustions being carried out at a non-standard temperature. The correction in molecular heat of combustion (*d*U/*dt*) is by Kirchoff's equation equal to the difference between the molecular specific heats of the substances concerned before and after combustion, and values for this are calculated for a large number of substances. The results for benzoic acid and nitrogen-containing bodies are based on experimental specific heats, those for others on molecular heats calculated by Kopp's rule. This gives — 26·3 for benzoic acid as against — 29 calculated, and consequently the standard heat of combustion of benzoic acid (6324 cal. 15°) is regarded as valid for 20° instead of 19·5° [Verkade, *Rec. Trav. Chim.*, 44. 800, 1925]. It is then shown that (*a*) if the standardization of the calorimeter and the combustion have been carried out at a non-standard temperature, the error is negligible in all cases where the rise in temperature is not more than 1°, and in cases where it is larger provided the heat of combustion is not small; and (*b*) if the combustion has been carried out at a non-standard temperature and the results been otherwise corrected, the correction due to the temperature coefficient of the heat of combustion is negligible provided the combustion has been carried out at a temperature not deviating greatly from 15–20°. C. A. S.

219. Heat of Combustion of Benzoic Acid in International Joules. W. Jaeger and H. v. Steinwehr. *Zeits. f. phys. Chem.* 135. 5–6. *pp.* 305–346, *Aug.*, 1928. *From the Reichsanstalt.*

Previous work is first briefly reviewed, following which improvements in technique are described for the more exact determination of the heat of combustion of benzoic acid. These refer to the stirring and other mechanical manipulations of the bomb, to the thermometric control, and to the calculation of the results. The new value, 26·437 kilojoules/*g*, deviates only slightly from the previous data of Fischer and Wrede (26·449) and Dickinson (26·436). H. H. Ho.

220. Laws of Combustion of Colloidal Powders. H. Muraour. *Comptes Rendus*, 187. *pp.* 374–375, *Aug.* 13, 1928.

The author has shown previously that for colloidal powders the total area $\int pdt$ of the pressure-temperature curve is a characteristic of a powder which is practically independent of the temperature of explosion (between 1900° and 3800°abs.) and of the maximum pressure (from 1000 to 4000 kg. per sq. cm.). It is now shown that the same integral $\int pdt$ is not modified if for a part of the given powder one substitutes a powder of different *vivacité*, whatever may be the temperature of the gas emitted by the added powder. In explanation it is suggested that the gaseous mass which surrounds the particles of the powder during combustion does not come in contact with the surface of the powder, but only the gaseous layer immediately in contact with, and emitted by itself. T. B.

221. Striated Photographic Records of Explosion Waves. C. Campbell and A. C. Finch. *Chem. Soc., J. pp.* 2094–2106, *Aug.*, 1928.

It has already been shown [see Abstract 2945 (1927)] that when the explosion-wave in certain gaseous mixtures is photographed by means of a moving-film camera the records are striated in appearance and the trace of the flame front is marked by regular undulations. Experiments are now recorded which appear to show that the phenomena can be accounted for by the flame travelling along a helical path and that the vibration of the apparatus or of a column of the gaseous mixture is not responsible for the effect. H. H. Ho.

222. Detonation Wave in Gaseous Mixtures and the Pre-Detonation Period. W. Payman. *Roy. Soc., Proc.* 120. *pp.* 90–109, *Aug.* 1, 1928.

A photographic method of observing the invisible shock or compression waves produced by the detonation of a gaseous mixture has been applied to the study of the pre-detonation period and the inception of the detonation. Evidence has been obtained of a novel type of compression waves, which are not due to the spark. They travel at speeds greater than that of sound, and appear to have their origin in the gases through which a flame has passed and to be due to renewed chemical activity behind the flame front. The detonation wave also appears to have its origin here. The paper also includes a detailed study of other features in the detonation of gaseous mixtures. T. M. L.

223. Temperature of the Vapour arising from a Solution. K. Schreber. *Zeits. f. tech. Phys.* 9. 8. *pp.* 277–285, 1928.

An experimental investigation of the temperature of the vapour above a solution. Full details of the procedure are given. It is found that the Gay-Lussac statement that the temperature of the vapour is the same as that of the solution is incorrect and that the results confirm Faraday's conclusion that the temperature of the vapour is that of the boiling point of the pure solvent medium. This is in good agreement with the observed values. S. G. B.

224. Vapour Pressure of Water over Sulphuric Acid-Water Mixtures at 25° C., and its Measurement by an Improved Dew-Point Apparatus. J. R. I. Hepburn. *Phys. Soc., Proc.* 40. *pp.* 249–259; *Disc.*, 260, *Aug.*, 1928.

A critical study has been made of data previously used by Wilson in the construction of a mean curve for the vapour pressure of water over sulphuric acid-water mixtures at 25° C. The observations of Sorel (employed by Wilson over the concentration range 44–82 % sulphuric acid) have been shown to be probably inaccurate, by calculations based on thermodynamics, and by determinations at 25° C., using an improved dew-point apparatus. The mean curve has accordingly been reconstructed, making use of the latest available data, and a set of most probable values for the vapour pressure has been compiled, taking into account the relative claims to accuracy of all investigators. AUTHOR.

225. Radiation from Inside a Circular Cylinder. H. Buckley. *Phil. Mag.* 6. *pp.* 447–457, *Sept.*, 1928.

An extension of work given in a previous paper [see Abstract 143 (1928)] in which the effect of multiple reflection from the walls of a uniformly heated infinite cylinder in building up black-body radiation is considered. An approximate solution is now obtained for the case of a finite uniformly heated cylinder, the results showing a close approximation to the ideal black-body radiator. The method is applied to the investigation of a circular cylindrical shaft or light well illuminated by a uniform sky. Finally, the case is considered of an infinite circular cylinder with an infinite longitudinal slit. The solution of the integral equation for this case is exact. A comparison is drawn showing the agreement of a radiator of the type of Ives's primary standard of light and the ideal black-body radiator. S. G. B.

226. Measurement of Radiation at about 5μ. K. E. Gould. *J.O.S.A. and R.S.I.* 17. *pp.* 198–206, *Sept.*, 1928.

The construction of a linear thermopile by a somewhat new method and the temperature control methods used in conjunction with it are described. The thermopile was used in measurements of the radiation from a black body at about 300° C. (infra-red radiation in the neighbourhood of 5μ). W. S. S.

227. Isotherms of Helium at − 183·0 to − 201·5° C. and Pressures of 3 to 8 Atmospheres. G. P. Nijhoff and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 31. 4–5. *pp.* 404–407, 1928. *Comm. No.* 188*b from the Phys. Lab., Leiden.*

The values of pv_A, d_A and B_A are tabulated. The values of B_A agree fairly well with those of Holborn and Otto. For the present work two new manometers were made and their dimensions are given. A. A. D.

228. Isotherms of Helium between − 103·6 and − 259·0° C. and at Pressures of 1·5 to 14 Atmospheres. G. P. Nijhoff, W. H. Keesom and B. Iliin. *K. Akad. Amsterdam, Proc.* 31. 4–5. *pp.* 408–409, 1928. *Comm. No.* 188*c from the Phys. Lab., Leiden.*

The results of pv_A and d_A over this range are tabulated. A. A. D.

229. Isotherms of Hydrogen at 0° C. and 100° C. G. P. Nijhoff and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 31. 4–5. *pp.* 410–412, 1928. *Comm. No.* 188*d from the Phys. Lab., Leiden.*

The method of measurement is very briefly indicated. Values of pv_A and d_A are tabulated. A further table is given showing the values of B_A and C_A at 0° C., 20° C., and 100° C. as found by different observers. A. A. D.

230. Isotherms of Hydrogen between − 225·5 and − 248·3° C. and Pressures from 1·6 to 4·2 Atmospheres. G. P. Nijhoff and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 31. 4–5. *pp.* 413–414, 1928. *Comm. No.* 188*e from the Phys. Lab., Leiden.*

The values of pv_A, d_A and B_A are tabulated. A. A. D.

231. Critical Isotherms and A. Wohl's Equation of State. R. Wegscheider. *Zeits. f. phys. Chem.* 135. 5–6. *pp.* 362–367, *Aug.*, 1928.

K. Wohl's results [see Abstract 2436 (1928)] are criticised and the conditions to be fulfilled by a critical isotherm are considered with reference to the author's views (*ibid.* 99. p. 361, 1921) and to A. Wohl's equation of state (*ibid.* 87. p. 1, 1914; 99. pp. 207, 226, 1921). T. H. P.

232. Critical Isotherms and A. Wohl's Equation of State. K. Wohl. *Zeits. f. phys. Chem.* 135. 5–6. *p.* 368, *Aug.*, 1928.

Remarks on Wegscheider's paper [see preceding Abstract]. T. H. P.

233. Measurement of Equation of State for Solid Argon. F. Simon and Frieda Kippert. *Zeits. f. phys. Chem.* 135. 3–4. *pp.* 113–128, *Aug.*, 1928.

The paper commences with a description of the apparatus employed.

The outstanding features are the type of bomb and the manometer, a manganin hair wire of diameter 0·03 mm. The temperature coefficient of manganin is small and the resistance increases linearly with the pressure. Full experimental details are given The thermal pressure of a condensed gas is thus measured directly, and the method is used for solid and liquid argon, solid methane, liquid oxygen and nitrogen. The results are given below.

Substance.	$\frac{\partial p}{\partial T}$ Atmosphere.	Temperature Interval in Degrees.
Argon (solid)	38	72·0–85·0 absolute
Argon (liquid)	25	84·5–90·1 ,,
Methane (solid)	28	78·0–90·1 ,,
Oxygen (liquid)	24	67·0–90·1 ,,
Nitrogen (liquid)	24	68·0–77·0 ,,

The density of solid Argon at 76° absolute was given by two determinations as 1·505. The compressibility of liquid argon, oxygen and nitrogen was determined from the known value of the dilatation coefficients and the values obtained for the pressures already quoted. They are given by:

Liquid argon at 86° absolute ... $K = 180 \times 10^{-12}$ absolute units.
Liquid oxygen at 82° absolute .. $K = 169 \times 10^{-12}$,, ,,
Liquid nitrogen at 75° absolute.. $K = 247 \times 10^{-12}$,, ,,

The quantity $\gamma = -\frac{d \log \nu}{d \log V}$, was calculated for argon. The value so obtained was 4·5, in contrast to 2·3 for metals and 1·8 for ionic lattice. It was, therefore, concluded that in consequence of its extraordinary high value for argon, the latter was a special substance, in order to presume the existence of a null point of energy. S. G. B.

234. Thermodynamics of Mixtures. V. Fischer. *Zeits. f. Phys.* 50. 5-6. *pp.* 419–424, 1928.

A theoretical and mathematical treatise on the introduction of: (*a*) temperature and space content as independent variables in the equation for mixtures; (*b*) the free energy, the internal energy and the heat content in the equilibrium conditions for a mixture of two components; and (*c*) pressure and space content as independent variables. S. G. B.

235. Generalised Gibbs Boltzmann Equation. F. R. Bichowsky. *Phys. Rev.* 32. *pp.* 494–496, *Sept.*, 1928.

A generalised form of the Gibbs Boltzmann canonical equation $1 = \int \phi(\epsilon/kT) e^{-(a+\epsilon)k/T} d\omega$ is derived by reversing the line of proof used by Gibbs in showing the correspondence of statistical formulæ with thermodynamics. The proof involves only the assumption of the first two laws of thermodynamics, the idea that thermodynamic quantities are the physical average of complicated molecular processes, and the assumption that energy, entropy and temperature give a sufficient description of the system considered. The equation allows a treatment of statistics of the most generalised type of systems. AUTHOR.

SOUND.

236. Elastic Impact on Struck String. R. N. Ghosh. *Phys. Soc., Proc.* 40. *pp.* 224–225, *June*, 1928.

A note criticising a previous paper by P. Das [see Abstract 694 (1928)] in which it was assumed that initially the velocity of the struck point was zero. W. H. Ge.

237. Velocity of Sound in Liquids at High Frequencies. J. C. Hubbard and A. L. Loomis. *Phil. Mag.* 5. *pp.* 1177–1190, *June*, 1928.

Describes a new method of measuring the velocity of high-frequency sound in liquids. A circular quartz plate 2 in. in diameter, with plane parallel faces, vibrates piezoelectrically at such frequencies that the compressional waves produced by it in a column of liquid are short compared with the dimensions of the apparatus. It is then found that the velocity of sound, measured by resonance, is independent of the materials and dimensions of the vessel. Sound velocities are given for water and mercury and various solutions of sodium chloride, potassium chloride and sodium iodide at several temperatures. Several thermodynamic coefficients for water and mercury are in good agreement with Bridgman's work. W. H. Ge.

238. Absorption of Ultrasonic Waves by Various Gases. T. P. Abello. *Phys. Rev.* 31. *pp.* 1083–1091, *June*, 1928.

Measurements of the absorption coefficient of ultrasonic waves of frequency 612 kilocycles have been made for CO_2, N_2, H_2 and He. The increase in the absorption coefficient ($cm.^{-1}$) at 612 kilocycles when air was replaced by a mixture containing 1 % by volume of the gas was found for CO_2 to be 0·029; for NO_2, 0·034; for H_2, 0·014; for He, 0·0025. For argon mixtures no absorption was observed. The fractional part of the beam transmitted by thin celluloid films at the end of the absorption tube increased with increase in percentage of CO_2 and NO_2, but decreased with increase in percentage of H_2 and He, agreeing qualitatively with Rayleigh's theory. W. H. Ge.

239. Vibration of Bells. A. T. Jones. *Phys. Rev.* 31. *pp.* 1092–1102, *June*, 1928.

A study has been made of the ten bells of the Harkness Memorial Chime at Yale University with results shown in the table:—

Partial	1	2	3	4	5	6	7	8	9	10
Relative frequency	0·50	1·00	1·20	1·49	2·00	2·56	2·96	3·28	3·80	4·06
Nodal meridians	4	4	6	6	8	8	10	8	10	12
Nodal circles	0	1	1	1	1	2	2	—	—	—

The amplitudes of the partials were studied from records (none reproduced) obtained by a microphone, amplifier and oscillograph. The fifth partial appears with surprising promptness and vigour and the influence of this upon the *strike note* phenomenon is considered, together with other observations. W. H. GE.

240. Measurement of Reverberation Period and Absorption. E. Meyer and P. Just. *E.N.T.* 5. *pp.* 293–300, *Aug.*, 1928. *From the Telegraphentech. Reichsamt.*

Describes a new method for determining the acoustical constants of a hall. Electrical generators, amplifiers, loud-speakers and galvanometers are used, and some of the accurate quantitative measurements possible with the apparatus are given, together with typical galvanometer records. W. H. GE.

241. Sound Generating and Measuring Apparatus. D. M. Crawford. *Science*, 68. *pp.* 209–211, *Aug.* 31, 1928.

Describes apparatus mainly intended for the study of architectural acoustics. Electrical generators, amplifiers and loud speakers are used as the source, and an audibility meter is used to control the intensity produced. The whole apparatus is stated to give a constant pitch of tuning-fork accuracy over a wide range of intensities and for long periods of time, and it can be made portable. W. H. GE.

242. Explosions at a Great Distance. M. Collignon. *Comptes Rendus*, 187. *pp.* 357–359, *Aug.* 6, 1928.

Continuation of a study of the properties of explosive sounds made in the open air [see Abstracts 1123 (1921) and 908 (1925)]. The audible harmonics observed arise from " infra-sounds " caused by explosions at distances greater than 120 km. Numerous observations have been made at a large number of stations with specific acoustical conditions of the surroundings, and the reduced observations (method not detailed) are shown in tabular form. **Errata,** *ibid. p.* 452, Aug. 27, 1928. G. E. A.

243. Acoustic Pressure and Velocity Relations on a Circular Disc and in a Circular Orifice. A. G. Warren. *Phys. Soc., Proc.* 40. *pp.* 296–298; *Disc.*, 299, *Aug.*, 1928.

It is shown that at low frequencies the pressure at the edge of a rigid diaphragm, vibrating in a hole in a thin wall, is $2/n$ times the pressure at the centre (the case of the moving-coil loud speaker). In the converse case of an acoustic wave impinging upon a circular orifice, the velocity increases towards the edge (the case of a resonator orifice). Were the medium non-viscous, an infinite velocity would be attained at the periphery. AUTHOR.

244. High-Frequency Sound Radiation from a Diaphragm. R. B. Lindsay. *Phys. Rev.* 32. *pp.* 515–519, *Sept.*, 1928.

By a hydrodynamical-acoustical method a calculation is made of the intensity of the high-frequency sound radiation from a circular piston-like oscillator at a distance from the oscillator greater than $2a$, where a is the radius. It is shown that there is no parallel " beam " of sound of cross-sectional area equal to the area of the oscillator, but that nevertheless most of the sound energy is contained in a cone of solid angle $\pi(0\cdot45\lambda/a)^2$ ster-radians, where λ is the wave-length of the radiation. Solution of the problem for points at great relative distance from the source then yields a result analogous to that obtained for the Fraunhofer diffraction of light through a circular aperture. The corresponding formula is $\pi(0\cdot 61\lambda/a)^2$. Comparison is made between the two methods and they are shown to be essentially the same, the difference in the formulæ being due to difference in interpretation solely. AUTHOR.

245. Alternating Air Currents. Z. Carrière. *J. de Physique et le Radium*, 9. *pp.* 187–204, *June*, 1928.

A study of the alternating flow of air through a small circular orifice in a thin plate. The flow is set up by means of a loud telephone which directs sound waves towards the aperture. The plate is in a horizontal position, and observation is confined to the axial flow on both sides of the opening, phosphoric anhydride dust is carried into the axial jet, is strongly illuminated through a rotating sector, and is synchronously observed by means of a stroboscopic apparatus. On both sides of the aperture the flow is broken up into numerous volutes or smoke rings. These are illustrated by a number of figures, and the method is capable of exhibiting simultaneously any two phases of the periodic motion and of measuring the corresponding time-interval. When a conical opening is employed the more or less symmetrical effect on the two sides of the plate is no longer maintained, and the contrast is further increased when a constant pressure is superposed on the alternating pressures caused by the sound waves. Waves of small amplitude give rise to an appearance of stationary stratification which might be utilised in measuring the velocity of efflux of the air. G. E. A.

246. Vibrations of Tuning Forks. E. A. Harrington. *J.O.S.A. and R.S.I.* 17. *pp.* 224–239, *Sept.*, 1928.

The energy dissipated by frictional forces in a tuning fork was studied by means of two electrically-driven tuning forks: (1) an ordinary fork; (2) a fork made by clamping two steel bars, with a rectangular block between them, in a vice so that very little energy was expended in moving the stand upon which the fork was mounted. The following properties were investigated: (1) the equivalent length of a rigid straight bar turning through the same angle as the tangent at the end of the prongs; (2) the relation between the current driving a fork and the deflections of the prongs produced, both for steady and resonant deflections; (3) the logarithmic decrement, and the effect on the logarithmic decrement of damping due to vanes at the ends of the prongs; (4) the energy due to emission of sound. It was found that: (1) a straight bar about 73 % of the whole length of the prong was approximately equal to the equivalent length; (2) the deflections of the prongs were proportional to the square of the current; (3) the change in the logarithmic decrement was roughly proportional to the area of the vanes; (4) about 3·5% of the total energy was converted into sound. AUTHOR.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

247. Current of the Dirac Electron Theory. W. Gordon. *Zeits. f. Phys.* **50. 9–10.** *pp.* **630–632, 1928.**

It is shown that the current separates into a conduction current and a polarisation current. W. S. S.

248. Electrical Condition of Hot Surfaces during the Adsorption of Gases. Part II. A Nickel Surface at Temperatures up to 850° C. G. I. Finch and J. C. Stimson. *Roy. Soc., Proc.* **120.** *pp.* **235–246,** *Aug.* **1, 1928.**

The apparatus previously described and illustrated in Part I [see Abstract 412 (1928)] was employed. It was found: (1) A nickel sheet becomes electrically charged when heated *in vacuo* or in contact with a gas. (2) The magnitude of the *in-vacuo* charge depends upon the temperature and previous history of heating. (3) At least one thorough oxidation and reduction is necessary to " normalise fully " the hot surface. (4) The nickel sheet becomes covered with an oxide layer when heated in oxygen, but this oxidised surface exhibits the same *in-vacuo* charge as the reduced oxygen-free surface. (5) The value of the charge due to the reaction product of a mixture of combining gases is identical, at all temperatures, with that due to the original gaseous mixture. (6) Argon or nitrogen diluted with 2 % oxygen gives the full charge due to either one of the latter gases. It is concluded that (i) the charge on a hot metal surface in contact with a gas is due to an activation of the adsorbed gas molecules; (ii) the initial reduction and oxidation of a nickel sheet brings about a rearrangement of the surface atoms of the metal; (iii) there are at least five different kinds of adsorption of a gas on a hot surface, ranging from a purely physical, electrically neutral adsorption or condensation to definite stable chemical compound formation which is likewise electrically neutral; and (iv) the electrical charging of a hot surface is unlikely to afford evidence of deep-seated occlusion. H. H. Ho.

249. Franklin's Kite Experiment and Energy of Lightning. A. McAdie. *Monthly Weather Rev.* **56.** *pp.* **216–219,** *June,* **1928.**

From available evidence the author concludes that Franklin's kite experiment did not precede his introduction of the lightning conductor rod. The author reviews the results obtained by Peek, C. T. R. Wilson, Simpson, Wormell and Schonland and Crabb regarding the potential differences, current and energy available in lightning discharges. The results obtained at Blue Hill Observatory on the fusion of kite wires during thunderstorms indicate a voltage of about $1 \cdot 3 \times 10^7$ volts, and the energy 11 kWh. The importance of a study of the side discharges or split-off flashes is urged as contributing to a knowledge of the process of the breakdown of the dielectric, the origin of the path, the concentration of electrons producing ionisation, and the nature of the explosive effect. R. S. R.

250. Electrokinetic Potential between the Solid and Liquid States of a Single Substance. F. Fairbrother and F. Wormwell. *Chem. Soc., J. pp.* 1991–1997, *Aug.*, 1928.

The production of an electric charge by the friction of a liquid against the same substance in the solid state was examined by a cataphoresis method. Sohncke in 1886 found that in the electrification produced by the friction of water against ice the water became negatively charged, which agreed with earlier experiments of Faraday. The same result was obtained in the experiments described in this paper and the investigation has been extended to other substances. In all cases when an electrokinetic potential was detected the solid was found to be positively charged relatively to the liquid. J. J. S.

251. Electrification of Water Drops. D. Nukiyama and H. Noto. *Japanese Journ. of Astron. and Geophys.* 6. 1. *pp.* 41–61, 1928.

A series of measurements was made with water flowing from a reservoir through an adjustable nozzle into an experimental chamber and falling through an electrical field maintained between two charged plates. Values of the ratio equilibrium potential (V), theoretical potential were plotted against the distance (*h*) of the nozzle from the upper plate for different potential differences (B) between the charged plates. It was found that V was greater than the calculated value for weak fields, but the ratio decreased as B increased. For B $>$ 20 volts, the ratio is less than unity. When the field is reversed, the ratio is less as B decreases and finally is even negative. The capacity effect of the falling drop, the removal of charge by the drop and a space charge effect are each examined and also the use of different liquids. The authors' results confirm those obtained by Maclean and Goto on the space charges produced by the interaction of water and air and also the waterfall effect, and this effect as well as induction must be considered in the theory of the water dropper. R. S. R.

252. Accumulation of Electric Charge on Thunderclouds. D. Nukiyama. *Japanese Journ. of Astron. and Geophys.* 6. 1. *pp.* 63–69, 1928.

The author applies the results obtained in an earlier paper [see preceding Abstract] to the cases of drops which slowly divide, drops splitting into others of different sizes, rain drops forming in an electrically neutral space, and the subdivision of large drops to explain the different charges acquired by rain drops. These results are applied to the formation of charges in the thundercloud, the effects of induction in increasing the charge, the predominance of negatively charged clouds of this type and the means by which positively charged clouds could result. Lastly, a means of measuring the real volume charge of rain drops is taken. R. S. R.

253. Origin of Cosmic Rays. R. A. Millikan and G. H. Cameron. *Nat. Acad. Sci., Proc.* 14. *pp.* 637–641, *Aug.*, 1928.

Brings evidence that cosmic rays do not originate in the interiors of stars but in interstellar space. If the interiors of stars were favourable to their production many of them would come from the sun, but the evidence shows that they do not. If the cosmic rays have their origins within the stars they cannot, even at the points of their origin, have an intensity more than ten times that which they have when they reach the earth's atmosphere for, if they had, then the cosmic-ray energy transformed into heat by absorption on the way out would yield a total heat outflow from the stars larger than the observed ten to one ratio.

E. E. F. d'A.

254. Intensity Changes of Cosmic Radiation. G. v. Salis. *Zeits. f. Phys.* 50. 11–12. *pp.* 793–807, 1928.

Measurements of cosmic radiation were made from June to September, 1927, in the Jungfrau region with a Kolhörster electrometer and the results expressed against the radiation from the earth when covered with snow or glacier ice to a depth of 10 m. After substraction of the residual rays which amount to 15–18·5 % of the total radiation, the ionisation for cosmic radiation amounts to 5·10 to 6·59 ions at 760 mm. Hg. From differences of radiation values arranged in sidereal time on the Mönch (4105 m. and 467 mm. Hg) and the Jungfraujoch (3500 m. and 504 mm. Hg) there resulted a coefficient of decrease of $4{\cdot}96 \times 10^{-3}\,\text{cm}^{-1}$. No systematic oscillations were found on the Jungfraujoch, but on the Mönch a real period was found, whose variations of amplitude exceeded by 2 or 3 times the probable errors due to the apparatus or observation. This amplitude amounted to 11 % of the total radiation, less than half of that found by the author in 1926. These changes had no apparent relation to meteorological changes. [See also Abstract 999 (1928).] R. S. R.

255. Statistical Treatment of Cosmic Ray Measurements. A. Corlin. *Zeits. f. Phys.* 50. 11–12. *pp.* 808–848, 1928.

The measurements of Steinke in Königsberg, Büttner and Feld on the Zugspitze, and Kolhörster and Salis on the Mönch and Jochrichter have been reduced by statistical means to find oscillations during the 24 hours of the cosmic radiations. These oscillations are found to be irregular and of two kinds. Three special problems of cosmic radiation are discussed. The curves connecting the mean values for sidereal time agree in seven different cases and this period is considered to be real. The amplitude appears to decrease with height but not in any simple way, and two main components are considered to exist: (1) a more uniformly divided hard radiation with irregular oscillations coming from space, and (2) a weaker radiation from a special part of the sky which causes the sidereal period. To explain the latter the author considers (1) errors of observation, (2) oscillations of α-particles, (3) atmospheric ionisation, (4) oscillations in atmospheric scattering, and (5) pure oscillations of rays of cosmic origin. A further review of Steinke's measurements confirms the last of these possibilities. An investigation of the influence of the sun on this radiation gave a negative result. R. S. R.

256. Oscillations of Cosmic Ultra-γ Rays on the Sonnblick (3100 m.) and in the Tyrol. V. F. Hess and O. Mathias. *Akad. Wiss. Wien, Ber.* 137. 2*a*. *No.* 5–6. *pp.* 327–349, 1928.

Measurements of ultra-γ rays were made in the summer and autumn, 1927, at Graz (380 m.), Lans in Tyrol (890 m.), Patscherkofel (1970 m.), and on the Sonnblick (3106 m.), using two Kolhörster radiation apparatus with a double suspension system and iron shielding to a thickness of 7 cm. Readings were made according to sidereal time. It was generally established that small irregular temporary oscillations occur, but an increase of amplitude with increase of height was not found. Although some curves indicate partial similarities, an agreement in the time of occurrence of the extreme value is generally not obtained. The details for individual stations are discussed. The presence, according to sidereal time, of the diurnal oscillation as found by Kolhörster and Büttner, could not be confirmed, but this may be due to different experimental conditions. Particularly the harder radiation penetrating the iron shield may have no diurnal variation, while the independent softer radiation yields a sidereal time period. Measurements on a glacier on the Sonnblick gave for the ultra-γ radiation a mean mass absorption coefficient for depths up to 10 m. of $2 \cdot 07 \times 10^{-3}$ cm.^{2}/g with a distinct hardening of the rays with increasing thickness. Experiments with and without the iron shield in Graz and on the Sonnblick gave a mass absorption for Fe of 8×10^{-3} cm.^{2}/gm. and in and of $3 \cdot 9 \times 10^{-3}$ cm.^{2}/gm. Differences are attributed to the scattering effect and the relative predominance of softer radiation components at greater heights. R. S. R.

DISCHARGE AND OSCILLATIONS.

257. Spark-Gap Discharges. H. Jacobs. *Arch. f. Elektrot.* 20. *pp.* 309–318. *July* 19, 1928.

A description is given of an investigation made with the kathode-ray oscillograph [see Abstract 181 (1928)] of various forms of discharge at a sphere spark-gap under different circuit conditions. A. W.

258. Measurement of Lags in Discharges. W. Clarkson. *Phil. Mag.* 6. *pp.* 312–317, *Aug.*, 1928.

Two methods used by the author in the measurement of lags in the occurrence of discharges through gases are described. Condenser or " dynamic " discharges chiefly are dealt with, as presenting the most general case. Two types of lag are distinguished, an interval between the application of the potential and the initiation of build-up, *i.e.*, a lag in " striking "; and an interval between the discharge striking and the maximum current, *i.e.*, a lag in " build-up." In each method the quantity diverted by a system in parallel with the discharge tube during the interval between the application of the condenser and the end of " build-up " is measured. The applied potential being assumed constant (at V_M), this quantity is determined by: (1) The charging up of a capacity K through a high resistance R, the increase in the voltage from V_0 to V_K being found. The time of extinction t is given by $t = KR \log_e [(V_M - V_0)/(V_M - V_K)]$. (2) The throw ϕ of a ballistic galvanometer of known constant K, the deflection for the steady current produced by V_M being θ. In this case $t = K\phi/\theta$. [See also Abstract 2745 (1927).] T. B.

259. Kathode Dark Space of the Glow Discharge. A. Wehnelt and G. Schmerwitz. *Ann. d. Physik*, 86. 6. *pp.* 866–870, *Aug.* 4, 1928.

An investigation was made of the kathode dark space by means of measurements with sounds. These measurements with small kathodes and relatively high current densities yield results for the course of the field as accurate as those found by Brose [see Abstract 1087 (1919)] by spectroscopic measurements of the Stark effect. The distance of the field maximum from the kathode is in close agreement with Brose's measurement. The results obtained by these sound measurements show that they are not inferior in accuracy to other newer methods. J. J. S.

260. Diffraction of Kathode Rays by Mica. S. Kikuchi. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 354–356, *July*, 1928.

Further details of the diffraction patterns described in an earlier paper [see Abstract 3284 (1928)] are now given. The black and white lines found when using thicker mica plates are attributed to multiple scattering. W. S. S.

261. Back Diffusion and Secondary Radiation of Kathode Rays of Medium Speed. K. H. Stehberger. *Ann. d. Physik*, 86. 6. *pp.* 825–863, *Aug.* 4, 1928.

If kathode rays of uniform velocity strike a metal surface, this sends out kathode radiation with velocity in the highest degree non-uniform. The cause of the radiation coming from the deeper layers of the metal is explained as back diffusion of primary electrons. This back diffusion is the end result of many deviations which the quick primary electron experiences in the interior of the metal. In the present paper an account is given of the determination of the distribution of velocity from a conductor exposed to radiation. The action of radiation from the walls of the enclosure is avoided. The radiation is divided into two portions, back diffusion and secondary radiation. The distribution of the velocities of the secondary radiation of the metals Au, Pb, Cu, and Al was examined in relation to various primary velocities (Vp) between 2000 and 10,000 volts. The range of the secondary radiation extended from 0 to about 36 volts and showed no dependence on Vp or on the rays. With an arrangement for measuring the electron emission in the normal direction the velocity distribution of the part of the radiation going out more quickly was observed. This portion embraces in rising degree velocities which are very much smaller than those of the impinging electrons, and are exclusively composed of back diffusion. Measurements were made of the ratio of the total possible radiation to the primary radiation, and of the relations between the two kinds of outgoing radiation—R and S. From the comparison of the total possible radiation with the ratio S/R it is concluded that in the Vp range investigated the initial secondary radiation is due exclusively to primary electrons traversing a backward course. From a similar comparison the back diffusion constants for Au and Al were obtained. The back diffusion thickness was found by two methods with a thin layer of platinum formed by kathode disintegration to lie between 80 and 120 $\mu\mu$ for the primary velocities between 4000 and 9000 volts. J. J. S.

262. Kathode Scattering. E. Blechschmidt and A. v. Hippel. *Ann. d. Physik*, 86. 7. *pp.* 1006–1024, *Aug.* 16, 1928.

In this, the fourth part of a discussion of the phenomena of scattering at the kathode, the influence of the material and condition of the kathode are considered. The theory developed is extended to include the rate of vaporisation and the heat diversion of the kathode metal, and quantitative equations are given. The intensity of scattering of base metals is experimentally dealt with, and the facts observed are found to support the theoretical exposition in all cases where the metals can be maintained with clean surfaces. [See also Abstracts 1112 and 1113 (1927)]. J. J. S.

263. Transmission of Kathode Rays through Thin Films. B. L. Worsnop. *Phys. Soc., Proc.* 40. *pp.* 281–284, *Aug.*, 1928.

The results of the experiments of G. P. Thomson [see Abstract 1355

(1928)] on the transmission of electrons through thin films are discussed. It is suggested that the explanation in terms of the Debye-Scherrer diffraction is untenable in certain cases. In particular for the case of celluloid films, and " amorphous " films generally, it is suggested that scattering of the mechanical waves at centres might account for the observed results. Calculation shows that the distance apart of the scattering centres is of the order of the distance between atoms. An analogy between this case and that of X-rays (Keesom and Smedt) is made, and it is shown that the test between a scattering and a diffraction origin of the rings is the relative diameters of the rings. A brief announcement of another " diffraction " experiment is made. AUTHOR.

264. Penetration of Electrons through Metallic Films. E. Rupp. *Ann. d. Physik*, 85. 8. *pp.* 981–1012, *May* 24, 1928.

The angular distribution of slow electrons (150–320 volts) transmitted through very thin metallic films is photographically examined. The films were those of metals with a cubical space lattice, including zinc and tin. The photographs show a dispersion of the electrons about the point of penetration of the ray and also electronic diffraction with discrete angles. The diffraction rings of the electrons may be assigned to the grating planes of the metal as determined from Röntgen photographs by the process of Debye and Scherrer. E. E. F. d'A.

265. Refractive Index of Electron Waves. L. Rosenfeld and E. E. Witmer. *Zeits. f. Phys.* 49. 7–8. *pp.* 534–540, 1928.

The experiments of Davisson and Germer [see Abstract 712 (1928)] and more recently those of Rupp [see preceding Abstract] show that to obtain agreement between observed and theoretical results in electron wave diffraction and reflection experiments, the electron wave-length in the crystal must be assumed to be greater than in free space. This corresponds to the existence of an excess potential within the crystal, the measurements leading to values of about 18 volts for Al, Cr, Ni, Cu, Ag and Au and 11 volts for Pb. By applying Sommerfeld's recent theory of metals and using the above values for the " external exit work," the long wave limit of the photoelectric effect for these metals is deduced and found to give approximately the right value with an assignment of 2, 3, or 4 conduction electrons to each atom, depending on the valency. W. S. S.

266. Radiation of Single Hydrogen Nuclei by Solid Bodies. C. Gerthsen. *Ann. d. Physik*, 86. 8. *pp.* 1025–1036, *Aug.* 25, 1928.

In a previous paper [see Abstract 2182 (1928)] it was shown that in the case of hydrogen canal rays reflected from metals the law of scattering for the particles reflected with approximately unaltered velocity is in essential characteristics the same as that for α-particles of large deflection angle. The intensity of the scattered particles reflected by different metals is proportional to the square of the ordinal number and the number of atoms per c.c. In the present paper experiments are described showing the existence of single canal-ray particles, which were observed by means of Geiger's counting apparatus. Application of this was made to investigate the dependence of the number of scattered hydrogen canal-ray particles on the angle and also the absolute number of such particles in a given solid angle. The results obtained were in very good agreement with Rutherford's formula for such scattering. [See also Abstract 2674 (1926).] A. W.

267. Recombination of Positive Ions with Free Electrons. R. d'E. Atkinson. *Zeits. f. Phys.* 51. 3–4. *pp.* 188–203, 1928.

An attempt was made to detect experimentally a recombination of positive ions with electrons on passing a pencil of caesium ions through a cloud of slowly moving electrons. The intensity of the positive ion beam was found to be the same whether or not it had passed through the electron stream. The negative result obtained is expressed more precisely by giving an upper limit to the probability of recombination. **Erratum,** *ibid.* 52. 3–4. *p.* 300, 1928. W. S. S.

268. Critical Potentials of Metallic Vapours. Part I. Copper. H. B. Wahlin. *Phys. Rev.* 32. *pp.* 277–283, *Aug.*, 1928.

Using a method for determining the critical potentials of metallic vapours in which the metallic vapour is produced in the neighbourhood of a gauze by vaporisation of the gauze, it has been found possible to determine a number of critical potentials in Cu vapour in the region 0–20 volts. The values found in the region 0–11 volts can be identified from the spectroscopically known energy levels. The interpretation of those above 11 volts is incomplete. Some of them agree with soft X-ray levels found by Thomas, and some with second ionisation potentials determined by Russell. Whether the remaining levels correspond to spark terms or not remains to be seen. AUTHOR.

269. Thermionic Emission. L. Tonks. *Phys. Rev.* 32. *pp.* 284–286, *Aug.*, 1928.

Electron emission experiments can throw light on the surface heat of charging only if the density of electrons in equilibrium with an emitting surface is the same whether evaporation occurs with constant surface charge or with surface charge equal (and opposite in sign) to evaporated charge. This equality is proved thermodynamically in the present note. AUTHOR.

270. Reflection and Refraction of Electrons by a Crystal of Nickel. C. J. Davisson and L. H. Germer. *Nat. Acad. Sci., Proc.* 14. *pp.* 619–627, *Aug.*, 1928.

This paper records a continuation of previous work [see Abstract 2471 (1928)]. The failure of the Bragg law for the electronic speeds used in these experiments (bombarding potentials up to 600 volts) may be ascribed to a refraction of the electron waves by the crystal or that the beams suffer total reflection at the surface of the crystal. Observations have now been undertaken to determine which view is correct and also whether or not refraction in the ordinary optical sense is actually a property of the crystal. Support is given to the last named, although the results are less simple than might be expected. For bombarding potentials above 150 volts the results are consistent with a dispersion curve represented by $\mu = (1 + a/v)^{\frac{1}{2}}$, but between 150–65 volts the situation is complicated and it is not yet certain whether this is independent of the order of the reflection. H. H. Ho.

271. Action of Strong Electric Fields on the Current from a Thermionic Kathode. N. A. de Bruyne. *Roy. Soc., Proc.* 120. *pp.* 423–437, *Sept.* 1, 1928.

Refers to Schottky's theory (*Phys. Zeits.* 15. *p.* 872, 1914). Not only do those electrons which are able to escape by their own energy in the absence of an external field have a Maxwellian velocity distribution, but electrons of ½ volt less energy than that corresponding to the work function also possess a Maxwellian velocity distribution. It is the field at the surface of the kathode which is the decisive factor in controlling the saturation current. Certain anomalous results are considered. The electrons with big energies have a Maxwellian velocity distribution; those with small energies have some other distribution which is unaffected by temperature. A. D.

272. Heat Development in an Ionised Gas in High-Frequency Electric Fields. S. Benner. *Arkiv. f. Mat. Astron. och. Physik, Stockholm,* 20. *No.* 15. *pp.* 1–11, 1927. *In German.*

The cases of plane and spherical condensers have been treated by calculation and measurement. On account of simplifying assumptions the calculation for the first case gives only the order of the effect. In the second case the quantitative agreement is good. An attempt was made to determine the presence of free electrons with purified nitrogen. A fault in the apparatus prevented this being done, but it was shown that the number of free electrons is not large. J. E.

273. Repartition in Space of the Initial Directions of Photoelectrons due to Monochromatic X-Radiation. P. Auger. *J. de Physique et le Radium,* 9. *pp.* 225–230, *July,* 1928.

Using apparatus similar to that previously described [Abstract 2372 (1927)], a new series of measurements was made, the Kα rays of tungsten being selected by reflection from a crystal of rock-salt. The results obtained are considered to be more reliable than those of previous experiments in which the radiations used were not perfectly homogeneous. The value now found for the angle of bipartition is 69°, the mean cosine being 0·313 and the asymmetry factor 3·3. The results are in agreement with the theory proposed by the author and Perrin. A. W.

274. Schrot Effect in High-Frequency Circuits. S. Ballantine. *Frank. Inst., J.* 206. *pp.* 159–167, *Aug.,* 1928.

In 1918 W. Schottky predicted theoretically that in an electrical circuit connected to a thermionic valve there would be fortuitous fluctuations of current due to the fact that the thermionic current is not continuous but is carried by discrete charges. Schottky's view of the phenomenon was a statistical one in which the behaviour and disturbance due to the individual electrons were lost. An alternative view which furnishes a clearer and more detailed picture is obtained by tracing the consequences of the passage of a single electron from filament to plate, and then to arrive at statistical values by assuming these individual processes to be random in time. The author demonstrates the Schrot effect (small shot effect) in a triode and finds that it increases with the frequency. E. E. F. d'A.

275. Oscillations in Ionised Gases. I. Langmuir. *Nat. Acad. Sci., Proc.* 14. *pp.* 627–637, *Aug.,* 1928.

In strongly ionised gases at low pressures, *e.g.*, in the mercury arc, the free electrons have a Maxwellian velocity distribution corresponding to temperatures ranging from 5000° to 60,000°, although the mean free path of the electrons may be so great that ordinary collisions cannot bring about such a velocity distribution; also, electrons accelerated from a hot kathode rapidly acquire a random or temperature motion which must result from impulses delivered to the electrons in random directions [see Abstract 1003 (1927)]. To explain these facts the assumption is made that electric oscillations of very high frequency and of short wavelength produce a scattering of the kind observed and such oscillations are now recorded. The region in which they occur contains balanced charges of ions and electrons and is termed the "plasma." These plasma oscillations are theoretically treated under the sub-sections of beam and ionic oscillations, and thermal equilibrium, and a comparison is made of the fields produced with those to be expected from a random distribution of electrons. The energy delivered to electrons by the field is separately considered, and a final section is devoted to plasma oscillations of greater amplitude. H. H. Ho.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

276. Supra-Conductivity on Schrödinger's Wave Equation and Fermi's Statistics. E. Kretzschmann. *Ann. d. Physik*, 86. 6. *pp*. 914–928, *Aug*. 4, 1928.

The author has given previously [see Abstract 2186 (1926)] a simple kinematic condition for supra-conductivity based on the rapidity of decay of spontaneous currents in a conductor under no forces. By applying this criterion, it is now shown that if the motion of the free electrons is determined solely by the Schrödinger wave equation and their velocity and energy distribution solely by the Fermi statistics, then for a macroscopically isotropic and homogeneous metallic conductor in which the elementary charges obey Coulomb's law of force and do not interpenetrate, the resistance is zero. Results of the previous investigation based on ordinary mechanics and the Boltzmann statistics are shown still to hold except for unessential numerical factors. W. S. S.

277. Electrical Conductivity of Solid NaCl at Room-Temperature. J. Gingold. *Zeits. f. Phys*. 50. 9–10. *pp*. 633–643, 1928.

Measurements have been made on the conductivity of (1) natural single crystals, (2) blue rock-salt, (3) artificially prepared single crystals, and (4) compressed pastilles. Previous researches by v. Seelen [see Abstract 200 (1925)] and by Lukirsky, Šĉukareff and O. Trapesnikoff [see Abstract 1780 (1925)] showed that NaCl belongs to the ionic conductor type and that the conductivity is mainly due to the Na ion. The results of the present measurements indicate that the conductivity of NaCl is due entirely to lattice distortions: only ions at the places of distortion are movable. In natural single crystals, lattice faults are relatively few and there is no available continuous paths for the ions; hence, a charge put into the crystal is entirely recovered on discharge. In blue rock-salt the faults are so numerous that there exist continuous paths for the movable ions and a real conductivity stream goes on. The notably greater conductivity of the pastilles is thus due to the greater number of internal cracks. J. E.

278. New Method for Measuring Conductivity. O. Redlich. *Zeits. f. phys. Chem*. 136. 5. *pp*. 331–352, *Sept*., 1928.

Exact measurements of the conductivity of electrolytes has shown that a dependence of the resistance-capacity of the cell on the concentration and nature of the electrolyte exists. In order to investigate this dependence an alternating-current compensation method was developed, by means of which it was possible to measure the conductivity of electrolytes with unloaded electrodes. The variations of the cell constant were determined, and the errors of the method are discussed. Comparison between measurements made by the compensation method and the bridge method at suitable concentrations of the electrolyte show that the new method is capable of yielding reliable results. F. J. B.

279. Circuits for the Measurement of Resistance. P. Geels and A. Michels. *K. Akad. Amsterdam, Proc.* 31. 6. *pp.* 542–551, 1928.

An attempt to devise a method of investigation for the universal comparison of resistance circuits, in order to obtain an estimate of the best circuit to use for specific cases, together with the maximum obtainable accuracy, etc. Five rules are stated: (1) The current in a resistance g is equal to the algebraic sum of the currents found to exist in g when the electromotive forces in the resistance net are considered separately. (2) Every resistance R in a current net may be replaced by an e.m.f. equal to iR (i being the current in R) without the currents in the net being altered. (3) The current i_g resulting from an e.m.f. equal to E in R is equal to i_R resulting from the same e.m.f. E in g. (4) If the conditions in a resistance net are such that e.m.f. in R leaves the link g without current, then the current i_g resulting from a second arbitrary e.m.f. brought into the net is independent of R. (5) If the conditions in a resistance net are such that the algebraic sum of two currents in g_1 and g_2 remains equal to 0 with an e.m.f. equal to E in R, then the current $i_{g_1} + i_{g_2}$ resulting from a second arbitrary e.m.f. brought into the net is independent of R. The latter is a new rule. These rules are now applied to the conditions of equilibrium in well-known circuits, *viz.*, Wheatstone, Thomson, and the potentiometer, etc., and the general nature of the comparison is derived. S. G. B.

280. Basic Measurements of the Effective Resistance of Condensers at Radio Frequencies. D. W. Dye. *Phys. Soc., Proc.* 40. *pp.* 285–295, *Aug.*, 1928.

Losses in condensers at radio frequencies may cause discrepancies when thermal methods are used to determine the effective resistance of inductive coils. The author considers the results obtained by Callis [see Abstract 1451 (1926)] reliable only for condensers where considerable losses occur. To measure the losses in a variable air condenser, the author used a special condenser consisting of a thick brass plate (P) hung by a 3-armed spider upon three quartz rods and located centrally between two other brass plates. P was attached centrally to a thick Cu block with a Hg cup at the top. The capacity was varied by using three plates of different thicknesses. The method of use and results obtained are given. It is shown that the losses at any reading and any frequency may be represented to a good approximation by three parts: (1) a fixed resistance; (2) an effective resistance represented by a constant power factor in the insulating material and thus inversely proportional to the square of the capacity; and (3) a component proportional to the square of the frequency and inversely proportional to the square of the capacity, and, thus, analogous to that given by a constant shunt resistance. In an Appendix it is shown that the conductor losses of this special condenser are negligible. R. S. R.

281. Dielectric Constant of Air at Radio Frequencies. A. B. Bryan and I. C. Sanders. *Phys. Rev.* 32. *pp.* 302–310, *Aug.*, 1928.

A radio frequency method has been used to measure the dielectric constant K of dry air free from CO_2 ,the value obtained being 1·0005893 for standard conditions of temperature and pressure. The probable error in $K - 1$ due to accidental variations is 0·34 %. The method is a modification of the usual heterodyne beat arrangement. Capacity changes produced when the pressure in the test condenser is changed are compensated by a suitable condenser in parallel. The beat note frequency is compared with that of a fork by means of Lissajous' figures. The test condenser is made of invar to avoid temperature effects. Short connecting wires are used to minimise lead-inductance effects. A few preliminary measurements made with a large direct-current voltage superimposed on the high-frequency voltage across the condenser indicate no change in the dielectric constant of air, hydrogen or ammonia. There is some indication that a discharge through the gas decreases its dielectric constant, but the effect is probably spurious. AUTHORS.

282. Dielectric Constants and Electric Moments of CO, COS, CS_2 and H_2S. C. T. Zahn and J. B. Miles, Jr. *Phys. Rev.* 32. *pp.* 947–504, *Sept.*, 1928.

By the heterodyne null method used in previous investigations measurements of the temperature variation of the dielectric constant were made on a further series of gases. The results are very well interpreted by the Debye equation $(\epsilon - 1)vT = AT + B$. The values for A are 0·000670 (CO), 0·002798 (CS_2), 0·001970 (COS), and 0·001223 (H_2S); and for B, 0·0078 (CO), 0·089 (CS_2), 0·352 (COS), and 0·722 (H_2S). These values of B give for the electric moment in c.g.s. e.s. units $\times 10^{18}$: 0·10 (CO), 0·326 (CS_2), 0·650 (COS), and 0·931 (H_2S). A comparison of all measurements made on the same apparatus with those of other observers is made, and a discussion of the notable discrepancies in this field is given. As a result of this investigation it seems likely that CS_2 and COS have a rectilinear structure like that of CO_2. AUTHORS.

283. Dielectric Constants of Binary Mixtures. The Electric Moment as Vector Quantity. J. W. Williams. *Am. Chem. Soc., J.* 50. *pp.* 2350–2357, *Sept.*, 1928.

Further experiments [see Abstract 435 and 1390 (1928)] are made with solutions of organic (mostly aromatic) compounds in benzene. Benzene itself is non-polar; the introduction of any atom or group will cause the formation of a polar molecule, and such an atom or group may be considered as a vector acting in a certain direction. The benzene ring is assumed to be planar, and the observations strongly support this assumption. The experiments further show that the substituents of both aliphatic and aromatic compounds will commonly interact with one another, so that the vectors will be acting in space rather than in a plane; the dipole moment of a molecule containing several groups can be calculated only on that assumption. X-ray determination of the structure of solids of the types $1, 4 - C_6H_4X_2$ and $1, 3, 5 - C_6H_3X_3$, which give finite electric moments, would be desirable for comparison with the molecular structures in the dissolved state. H. B.

284. Nature of Dielectric Losses. H. Schiller. *Zeits. f. Phys.* 50. 7–8. *pp.* 577–579, 1928.

A further reply to the criticism of H. Joffe regarding the validity of his conclusions based on the work of Sinjelnikoff and Walther. A new survey of the whole question is outlined, including the work of Joffe. The author concludes that if all the phenomena were duly regarded his earlier statement would be vindicated, *viz.*, that the conductivity conditions, etc., can be explained by an alteration of the limits of the movement of the ions, together with a simultaneous increase in their mobility caused by the high field strength. Smekal has explained the mechanism of such phenomena. S. G. B.

285. Electrotechnical Insulating Materials. H. Stäger. *Kolloid Zeits.* 46. *pp.* 60–66, *Sept.*, 1928.

A general theoretical paper in which the insulating properties of gaseous insulators such as air, of liquid insulators such as oils, and of solid insulators such as porcelain, mica, asbestos and rubber are considered, particularly from a colloidal chemical standpoint. J. K.

286. Photoelectricity. W. Bragg. *Roy. Inst., Proc. Advance Proof* [11 *pp.*] *Received Aug.*, 1928.

A survey of recent experiments on photoelectricity and their bearing upon physical theories. Special reference is made to the work of Compton, Raman, Davisson and G. P. Thomson. E. E. F. d'A.

287. Photoelectric Thresholds of Potassium. Jessie Butterworth. *Phil. Mag.* 6. *p.* 352, *Aug.*, 1928.

A correction [see Abstract 2807 (1928)]. E. E. F. d'A.

288. Photoelectric Effects from Water and Aqueous Solutions. L. Counson and A. Molle. *Arch. des Sciences*, 10. *pp.* 231–242, *July–Aug.*, 1928.

Distilled water shows photoelectric effects over the range of wavelength 2000 to 1300 Å. The results cannot be attributed to impurities adsorbed at the surface. Concentrated solutions of halogen salts are photoelectrically less active and solutions of salts containing oxygen more active than pure water. F. J. W.

289. Experiments on the Light-Sensitivity of Commercial Selenium Cells. G. P. Barnard. *Phys. Soc., Proc.* 40. *pp.* 240–246; *Disc.*, 246–248, *Aug.*, 1928.

As the result of an experimental investigation, it is shown in Part I that the change in conductance C due to a given intensity of illumination I is proportional to some power of the illumination I—*i.e.*, $C \propto I^x$. The index value x varies from cell to cell, and is probably dependent on the construction of the cell. A sensitivity curve is given.

In Part II some filter experiments are described, from which it appears that the change in conductance of selenium cells is dependent, not on the number of foot-candles incident on the cell, but rather on the amount of radiant energy received. Contrary to general belief, it is shown that, for the same amount of energy received, the action of the infra-red is relatively much weaker than that of some shorter wave portion of the spectrum. Some experiments on the decay of conductance of selenium after exposure to radiation from various portions of the visible spectrum indicate that, throughout a large portion of the visible spectrum, the internal state of the selenium, as determined by the change in conductance, is independent of the wave-length of the exciting radiation. A brief note on the nature of the light-action in selenium cells is added. AUTHOR.

290. Demonstration of a Simple Practical Application of the Properties of Selenium Cells. G. P. Barnard. *Phys. Soc., Proc.* 40. *p.* 342, *Aug.*, 1928.

The arrangement enabled the light falling on the selenium cell to be interrupted periodically at a given frequency. The consequent variations in the current through the cell due to a constant e.m.f. were amplified, using an intervalve transformer, and were converted into the corresponding acoustic frequency by means of a loud speaker. W. S. S.

291. Non-Inductive Potential Divider of High Precision. *Journ. Sci. Instruments,* 5. *pp.* 257–258, *Aug.*, 1928.

The instrument possesses four dials and a slide wire. The total resistance is 1000 ohms, and this is subdivided by the dials and slide wire to 0·001 ohm, each graduation on the slide wire thus giving one millionth part of the total resistance. The subdivision is arranged on the Thomson-Varley principle. All coils in the potential divider are non-inductively wound. The chance of contact trouble is reduced by the use of the " dual contact " type of switch. With this dial pattern the difficulty of making a double travelling contact arm on one side of the centre only is avoided. R. S. R.

292. Contact Potential in the Dolezalek Electrometer Connected Idiostatically. L. F. Richardson. *Phys. Soc., Proc.* 40. *pp.* 234–238; *Disc.*, 238–239, *Aug.*, 1928.

It was found that the deflection x was related to the voltage V by the formula $x = k\{\frac{1}{2}V^2 + \eta V\}$, k being constant from month to month, but η varying from 0·3 to 1·2 volts on different days. If it be desired to measure V, it is, therefore, essential to reverse the polarity in order to eliminate η. AUTHOR.

293. Simple Gold-Leaf Electrometer for High-Frequency Measurements. S. Ray. *Phys. Soc., Proc.* 40. *pp.* 307–311, *Aug.*, 1928.

A gold-leaf electrometer of the attraction type has been designed to supply the need for a simple instrument that can be used to measure voltages down to a few volts in high-frequency circuits, and which permits of precise indications of exact resonance in a simple circuit containing inductance and capacity. The fixed element is a metal plate covered with a thin sheet of mica. The moving element is a narrow strip of gold leaf stiffened with a very light, tubular glass fibre extending almost up to the point of suspension of the leaf. The lower end of the glass fibre serves as the pointer. Simple means are provided for varying the sensitivity between wide limits. The instrument will detect voltages as low as 4 volts and has a low capacity (2 to 4 micro-microfarads). It also possesses the advantages of quick response and negligible power consumption. Instances of its application are given. AUTHOR.

294. Quartz Fibre Electrometer. D. R. Barber. *Phil. Mag.* 6. *pp.* 458–465, *Sept.*, 1928.

The silvered quartz fibre is suspended between two insulated metal plates, the whole being enclosed in a glass tube, silvered on the inside and provided with two windows. The method of coating the fibre by spluttering is described as well as the technique of handling and mounting the fibres. The instrument was directly calibrated by applying known potential differences to the fibre, and the results are compared with those of other workers using different types of electrometer. F. S.

295. Kathode-Ray Oscillograph. E. Sommerfeld. *Arch. f. Elektrot.* 20. *pp.* 607–618, *Sept.*, 17, 1928; *and* **W. Rogowski, E. Sommerfeld and W. Wolman.** *Ibid. pp.* 619–624, *Sept.* 17, 1928.

A kathode-ray oscillograph is described with glow kathode, acceleration grid, and enclosed photography, sensitive to small electric tensions (0·1 volt per cm.). In the later paper it is shown how to improve the working by a vacuum arrangement. A. D.

296. Long-Period Galvanometer. D. C. Gall. *Journ. Sci. Instruments,* 5. *pp.* 280–281, *Sept.*, 1928.

The magnetic properties of a galvanometer coil are used to increase its periodic time instead of to decrease it, as is usually the case. AUTHOR.

297. Adjustable Thermostat. B. Noyes, Jr. *J.O.S.A. and R.S.I.* 17. *pp.* 127–131, *Aug.*, 1928.

Details are given for the construction of a sensitive high-temperature thermostat, consisting of a thermocouple (copper-constantan for temperatures up to 650°, platinum-platinum rhodium for higher temperatures) mounted in a furnace, a potentiometer, photoelectric cell, vacuum tube, two relays, and several slide resistances and batteries. The thermal e.m.f. is balanced on the potentiometer, connected to which is a Leeds and Northrup Type R galvanometer with a ½-in. mirror. Light from a ribbon filament lamp of 108 watts passes through the condensing lens and is reflected by the galvanometer mirror to a photoelectric cell. The apparatus is so arranged that when the light falls on the photoelectric cell, the plate current of the vacuum tube causes the galvanometer relay to open the primary circuit of a second relay, thus increasing the current in the furnace. It was found possible to control the temperature to within 1°, the accuracy depending chiefly on the constancy of the 110 volt supply. The regulating temperature may be changed with ease, and the arrangement also has the advantage that the usual accidents which might occur would all tend to decrease the temperature in the furnace, rather than cause it to overheat. L. L. B.

298. New Form of Thermopile. H. Keefer. *Phys. Zeits.* 29. *pp.* 681–683, *Sept.* 15, 1928.

Description of an improved form of thermopile with thin strips of copper and constantan or iron and constantan, with a new arrangement of the junctions. J. J. S.

ALTERNATING CURRENTS AND MAGNETISM.

299. Demonstration of Some Recent Studies in Alternating Magnetism and some Possible Applications. W. M. Mordey. *Phys. Soc., Proc.* 40. *pp.* 338–339, *Aug.*, 1928.

The distribution of pulverised magnetic metals and minerals when sprinkled on cardboard held in the field of an a.c. magnet was demonstrated. A practical application might be the separation of the constituents of powdered ore, which are differently attracted or repelled by the alternating magnetic field. W. S. S.

300. Origin of Magnetism due to Atomic Structure. K. Honda. *Tohoku Univ., Sci. Reports,* 17. *pp.* 997–1009, *Sept.,* 1928. *In English. Report No.* 201 *from Research Inst. Iron, Steel and other Metals.*

The paper has already been published in German in the *Zeitschrift für Physik,* 47. 1928 [see Abstract 1984 (1928)].

301. New Type of Ferromagnetic Frequency Multiplier. E. Rouelle. *Comptes Rendus,* 187. *pp.* 39–41, *July* 2, 1928.

Ordinary types of ferromagnetic frequency multipliers produce only odd harmonics of the input voltage. It is shown that the frequency reducer of Mauduit and Fallou, which yields sub-harmonics, may be modified so as to work as a multiplier giving even harmonics of the input voltage without employing direct current. The operation of such a multiplier may be started spontaneously by a variation of one of the circuit parameters. In certain circumstances, interesting heat phenomena may be observed before initiation. Various anomalies in the current theories of frequency-changing transformers are explained. L. L. B.

302. Effect of Methods of Demagnetisation on the Energy Required to Magnetise Steel. J. D. Ball. *Frank. Inst., J.* 206. *pp.* 181–200, *Aug.,* 1928.

Hysteresis losses in magnetic materials have been indicated to be less when tested by alternating-current methods than when tested by direct-current or step-by-step methods. The paper discusses the relative merits of the different methods and then proceeds to explain the fact that at very low flux density the B-H curve does not show correspondingly low flux changes with increasing H. Two reasons may be ascribed for the considerable field strength necessary to build up the flux density: (1) The static inertia of the magnetic elements involved. (2) The continuous motion of magnetic elements into different states may be accomplished with less energy, than by continuous starting and stopping. The problem of the exact explanation is tackled, and initially five methods are discussed. For the purpose of the tests two rings were used, one of iron and one of silicon-steel. Three different methods were used to obtain zero flux from various maximum flux values. B-H curves were obtained after demagnetisation by the three methods, and from the maximum values of these B-H curves hysteresis loops were taken. The methods of demagnetisation were: (1) Current reversals through a magnetising winding, gradually reducing current values to zero. (2) Application of a negative current of sufficient strength that the resultant flux value would be such that upon withdrawal of current the flux value would be zero. (3) Same method as (2) except that zero flux was approached from direction of opposite polarity. The resultant B-H curves differed from each other and depended both on their origin and on the method of demagnetisation previously employed. B-log H curves were plotted and were found to be linear over part of the range. Attempts to increase the number of steps in the determinations to test the increase or otherwise of energy loss with such procedure were inconclusive. S. G. B.

303. Permeability of Iron containing Rings. U. Retzow. *Phys. Zeits.* 29. *pp.* 534–538, *Aug.* 1, 1928.

A discussion of the magnetic properties of various magnetic alloys, *e.g.*, Heusler, Permalloy, Invariant, Hypernik, etc. It is shown that the permeability reaches a maximum value in the ring form as compared with the solid mass or square type. The figures for all types are given in the form of a table, and the high value of the ring form is obvious. The flux through the various forms in armature winding is also discussed.
S. G. B.

304. Magnetic Susceptibility of Sodium and Potassium. C. T. Lane and E. S. Bieler. *Roy. Soc. Canada, Trans.* 22. *Sect.* 3. *pp.* 117–123, *Jan.*, 1928.

Experiments indicate that the atoms of alkali elements consist of a tightly bound " noble gas " core with a more loosely bound valence electron; also that there is only one conducting electron per atom in these metals. There is strong indication that the valence electron becomes the conducting electron, which, according to Bohr, should make no contribution to the susceptibility. Pauli, however, considers that their contribution should be distinctly paramagnetic. The present experiments were undertaken to decide between the two views, and measurements of the mass susceptibility give K, $+ 0 \cdot 54 \times 10^{-6}$, Na, $+ 0 \cdot 65 \times 10^{-6}$. These are in fair agreement with the values calculated by Pauli. G. E. A.

305. Magnetic Studies on Salts, with Particular Reference to those with Complex Ions. L. A. Welo. *Phil. Mag.* 6. *pp.* 481–509, *Sept.*, 1928.

Of the 124 salts tested, in the form of powder, the paramagnetic ones were studied by the method of Foëx and Forrer [see Abstract 2708 (1926)], whilst diamagnetic salts were tested by the Gouy method. The salts are grouped under eight different headings, and the paper should be referred to for more particular information. G. E. A.

306. Magnetostriction. A. Schulze. *Zeits. f. Phys.* 50. 7–8. *pp.* 448–505, 1928. *From the Reichsanstalt.*

A description of an exact method for the determination of magnetostriction is outlined, obtained by the estimation of the alteration in the capacity of two superposed high-frequency circuits. Samples of iron and nickel of various degrees of purity were examined, as also cobalt and bismuth, and their magnetostrictive behaviour investigated. Similarly a large series of manganese alloys and pure electrolytic nickel and iron alloys were treated, and the influence of previous temperature handling was determined. The McKeehan theory of the initial permeability of permalloy is proved invalid. Iron-silicon, iron-manganese alloys were investigated with a view to the elucidation of the effect of constitution on the influence of magnetostriction. The connection between magnetostriction and other physical characteristics was not confirmed. It was established that the form of the striction curve is largely influenced by the kind of iron material. In the case of nickel and cobalt the contraction was found to be the greater, according to the purity of the metal. No magnetostriction was observed in the case of bismuth. In the case of iron-nickel alloys the nickel concentration is of greatest importance. At 81 % nickel there is a zero value for the magnetostriction. A contraction or dilatation occurs according as the Ni content is greater or less than 81 %. It is shown that previous heating and thermal treatment greatly affect the results and the McKeehan theory is disproved thereby. Full details are given of each sample examined, and reference should be made to the original for the complete results. S. G. B.

307. Magnetostriction of a Single Crystal of Nickel. Y. Masiyama. *Tohoku Univ., Sci. Reports,* 17. *pp.* 945–961, *Aug.,* 1928. *In English. Report No.* 200 *from the Research Inst. for Iron, Steel and other Metals.*

The longitudinal and transverse effects of magnetic elongation of a single crystal of nickel were observed for different orientations of the ellipsoids and different strengths of field. In all directions, the longitudinal effect is always a contraction for all fields; the contraction is largest in the direction [100], less in the direction [110], and least in the direction [111]. The transverse effect is just the reverse of the longitudinal one. Under a constant field, the variation of these effects with respect to the orientation of the ellipsoids is periodical, the period being 90°, 180°, and 60° for the planes (100), (110) and (111) respectively, as in the case of magnetisation. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

308. Report of Forty-Five Cases Treated with Radium during the Year 1927. Maurice R. J. Hayes. *Roy. Dublin Soc., Proc.* 19. *pp.* 43–47, *Sept.,* 1928.

309. Report for the Irish Radium Committee (Royal Dublin Society) of Radium Work carried out in the Year 1927. W. C. Stevenson. *Roy. Dublin Soc., Proc.* 19. *pp.* 47–53, *Sept.,* 1928.

310. Portable X-Ray Apparatus. E. J. H. Roth. *Brit. J. of Radiology,* 1. *pp.* 247–253, *July,* 1928.

The uses of portable X-ray apparatus for patients who cannot be moved are discussed on general grounds, and this is followed by a description of a portable apparatus employing the Philips "Metallix" metal X-ray tube, with illustrations. B. J. L.

311. Protection and Working Conditions in X-Ray Departments. G. W. C. Kaye. *Brit. J. of Radiology,* 1. *pp.* 295–314, *Sept.,* 1928.

Various countries, including England, have already suggested protection recommendations. Recently the Second International Congress at Stockholm adopted international recommendations. A general review is made of the English recommendations. The biological basis of protection is briefly discussed. Various curves are given showing the X-ray absorptive power of lead for various applied voltages and for different metals as brass, steel, and materials, as lead glass, lead rubber, and barium sulphate cement and brick. The remainder of this article follows the British protection recommendations which have frequently been discussed in the literature. B. J. L.

312. New Departure in X-Ray Technique. A. Salmony. *Brit. J. of Radiology,* 1. *pp.* 327–328, *Sept.,* 1928.

Comments upon an apparatus due to Gottheiner in which reduced serial photographs are taken of the X-ray fluorescent screen shadows of the stomach, etc. This reduces the cost of examination as compared to the present method of producing large non-reduced films in such work. This method may render cinematography practicable. No details are given of the method. B. J. L.

313. Use of a Broad Focus Coolidge Tube In Accurate Radiographic Localisation. O. Stuhlman. *Frank. Inst., J.* 206. *pp.* 345–353, *Sept.*, 1928.

Of various methods of radiographic localisation the triangulation method is most used. In this method it is invariably assumed that the geometrical origin of the radiation is at the tube target face. Whilst this is approximately the case in a fine focus Coolidge tube, it is not the case in a broad focus tube. The author shows the emission of radiation then occurs from two principal areas upon the tube target, and the interaction of the radiation from these two areas gives rise to a virtual focus some distance from the target face. The geometry of this virtual focus is discussed, and a practical method of its determination is given. B. J. L.

314. Process to Obtain Maximum Output of Short-Wave Ultra-Violet Rays. N. Iarotsky. *Comptes Rendus*, 187. *pp.* 459–461, *Sept.* 3, 1928.

In practical phototherapy either carbon arc lamps or mercury-vapour arcs are used. The former give ultra-violet radiation analogous to natural sunlight, but also much undesired heat radiation. The latter give non-homogeneous spectra; and Rubens and Bayer have recently shown the presence of heat radiations. The author has utilised a quartz mercury-vapour arc, which is illustrated, and differs from the normal mercury arc by working at 80,000 instead of 20 to 80 volts. This gives a radiation as low as 253 $\mu\mu$, as compared to 579 $\mu\mu$ of the usual arc, and an extremely small luminous and heat radiation. It is claimed that this lamp does not require heat absorbing filters and has a rapid lethal effect upon bacteria, without noxious effects upon the tissues. B. J. L.

315. Kinetic Theory of Neuro-Muscular Excitation by Short Waves. P. Fabre. *Comptes Rendus*, 187. *pp.* 482–485, *Sept.* 10, 1928.

The first stage of electrical excitation of tissue consists of the production of an internal ionic charge. The metallic ions so accumulated then exchange charges with colloidal ions of the tissue with a velocity which is characteristic of the particular tissue. The author investigates this transference of charge mathematically and finds the chronaxy is inversely proportional to the velocity of reaction of the tissue, to the number of ions of the protoplasm and to the number of ions per cubic centimetre. A paradoxical result is that easily excited tissues should have considerable chronaxy which agrees with experiment. The paper is largely mathematical. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

316. Adsorption of Vapours on an Amalgamated Platinum Surface. J. W. Smith. *Chem. Soc., J. pp.* 2045–2051, *Aug.*, 1928.

Measurements are made of the adsorption of water vapour and of benzene vapour on an amalgamated platinum surface at pressures near the saturation values. Such a surface is permanent in both vapours, but not in the laboratory atmosphere. Both cases show definite effects of the type found by McHaffie and Lenher; and thus support their view that under such conditions multimolecular adsorbed films are produced, in spite of the fact that the surface, being virtually a liquid mercury surface, is presumably incapable of containing capillary cavities of the type postulated by Fraser, Patrick and Smith. In the amalgamated vessel the vapour pressure of the liquids was always low—to the extent of 1·3 mm. in the case of water and 1·6 mm. with benzene. This was constant throughout the temperature range investigated. J. N. P.

317. Dipolar Nature of Adsorbed Gas Molecules. A. Magnus. *Zeits. f. Elektrochem.* 34. *pp.* 531–533, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

The van der Waals equation is considered in this connection and is modified so as to read: $\left(p - \frac{a}{v^2}\right)(v - b) = RT$. All observations seem to indicate the dipolar nature of adsorbed gases; for example, if water in silicic acid gel is heated to 300° in high vacuum, only 4 % is expelled. J. K.

318. Adsorptive Combination. H. Cassel. *Zeits. f. Elektrochem.* 34. *pp.* 536–538, *Sept.*, 1928. *Paper read bfeore the Deut. Bunsen Gesell., Munich, May*, 1928.

Reference is made to the work of Magnus [see preceding Abstract]. The conclusion arrived at is that in so far as the theory of adsorption refers to the exchanges occurring at the boundary layer of the neighbouring molecules of the adsorbed molecules and the adsorbens, there is a complete analogy to the theory of liquid mixtures having a solid phase present. J. K.

319. Monomolecular Character of the Adsorption of Gases at Glass and Wood Charcoal. H. Zeise. *Zeits. f. phys. Chem.* 136. 6. *pp.* 385–418, *Sept.*, 1928.

Adsorption experiments at a glass surface with methane, nitrogen, oxygen and hydrogen at 90° abs. and at pressures between $2 \cdot 10^{-4}$ and $7 \cdot 10^{-2}$ mm. give results differing quantitatively from those of Langmuir, since they yield for the adsorption isotherms the equation: $q = \sqrt{k_1 k_2 p/(1 + k_2 p)}$. Consideration of this equation on the lines laid down by Langmuir [see Abstract 1279 (1918)] indicates that two adsorption positions hold one gas molecule. Series development shows that Freundlich's exponential equation for the adsorption isotherms is only a first approximation to the author's relation. Interpretation of this equation leads qualitatively to the consequence that adsorption at glass proceeds monomolecularly, this conclusion being in agreement with Langmuir's results.

The results of adsorption measurements with methane, nitrogen and oxygen at 90° abs. and at pressures between 4 and 307 mm. fail to reveal any polymolecular effect in the sense of Eucken and Polányi's theories. Application of Langmuir's theory to experimental data obtained with wood charcoal by Titoff [see Abstract 549 (1911)], Homfray [see Abstract 1519 (1910)] and Richardson [see Abstract 1374 (1917)] shows that these correspond well with Langmuir's equation for the simplest case, whereas most of the data deviate systematically from Polányi's theory [see Abstract 1867 (1921)] by amounts far exceeding the possible experimental errors.

With the values obtained by Williams [see Abstract 451 (1920)], Eucken [see Abstract 1468 (1914)] and Iliin [see Abstracts 2372, 2617 (1925)] on the basis of their theories, for the adsorbing area per gramme of wood charcoal, the number of the maximum adsorption positions ($N_{max.}$) per sq. cm. of charcoal surface is determined from Langmuir's equation. In agreement with the above qualitative indication, the values thus found for $N_{max.}$, namely, $8 \cdot 10^6 - 5 \cdot 10^6$ sq. cm. per gramme, are smaller than the number of molecules in a monomolecular layer of the liquefied gas. T. H. P.

320. Solutions. Part I. Freezing-Point Diagrams and Latent Heats of Evaporation of Binary Mixtures of Volatile Liquids.

W. F. Wyatt. *Faraday Soc.*, *Trans.* 24. 8. *pp.* 429–438, *Aug.*, 1928.

In order to investigate the forces operating between the molecules of the components of binary liquid mixtures preliminary considerations of the latent heats are made. Tyrer's results (*Chem. Soc.*, J. 99. *p.* 1633, 1911; 101. *pp.* 81, 1104, 1912) are recalculated to show the changes of internal molal latent heat with concentration for the systems acetone-chloroform, alcohol-carbon tetrachloride, alcohol-benzene and benzene-chloroform, marked changes of slope in the curves being observed in the first three of these systems. A similar change of slope is noticed for the system acetone-chloroform when the molal heat capacity is plotted against the molecular percentage of chloroform in the mixtures. The freezing-point diagrams show that a compound of m.pt. − 99·5° is formed between 1 mol. of acetone and 1 mol. of chloroform. The system alcohol-carbon tetrachloride shows a transition point on the liquidus curve at − 47·6°, corresponding with 44·6 % of the tetrachloride. The system alcohol-benzene exhibits no transition point, but the freezing-point curve is displaced considerably to the alcohol side. A normal eutectic curve is given by the system benzene-chloroform. Analysis of the solids separating from the freezing mixtures gives results indicating the formation of extended series of solid solutions for these systems. With alcohol-carbon tetrachloride, the transition point is due to conjugate solid solutions, the difference in molecular concentrations of these at the transition temperature being of the order 5 %. T. H. P.

321. Equilibria in Systems containing Surface-Distributed Phases, in Relation to the Spontaneous Increase in the Area of Microscopic Images.

N. v. Raschevsky. *Zeits. f. Phys.* 51. 7–8. *pp.* 571–583, 1928.

The monomolecular layers forming under certain circumstances at the surface of solutions are here considered as independent phases, the equilibrium in a closed system, consisting of a space-expanded phase and a two-dimensional surface phase, being investigated on the assumption that the two phases undergo chemical interaction. It is found that, for a given volume of the system, the total free energy F generally depends on the area of the surface, so that there may be a definite area with which the minimum of F and, therefore, stable equilibrium corresponds. For this value of the area the capillary pressure disappears, so that a free liquid system may assume non-sphericity of shape. The alterations of the system occurring on gradual change of the total mass of the components contained in the system are considered, and it is found, as a consequence of the above results, that, under some conditions, there may occur spontaneous increase in the surface which is expressed in extension or division of the system. T. H. P.

322. Free Energy Changes accompanying the Solution of Ions in Water. T. J. Webb. *Am. Electrochem. Soc., Trans.* 51. *pp.* 559–568; *Disc.*, 568–570, 1927.

The free energy of hydration of a chemically unhydrated ion is deduced in a manner less equivocal than that of Born. The dielectric constant of water is not taken as a constant in the immediate vicinity of the ion. Account is taken of the energy resulting from the compression of the solvent in the immediate vicinity of the ion. Results are calculated and tabulated for ions of the alkali metals, and for several other ions. The effective radii of the ions in solution was found to be about 0·47 Å. greater than those of Bragg for crystals. F. J. B.

323. Copper Hydrosols of Low Electrical Conductivity. G. T. R. Evans. *Faraday Soc., Trans.* 24. 8. *pp.* 409–412, *Aug.*, 1928.

By means of a copper arc carrying a current of 8 to 10 amperes at about 80 volts in conductivity water (conductivity below $1 \cdot 10^{-6}$ ohm^{-1} cm.$^{-1}$) kept at about 20°, deep brown colloidal copper solutions with conductivities varying from $0 \cdot 30$ to $0 \cdot 60 \,.\, 10^{-6} \,.\, \omega^{-1}$ cm.$^{-1}$ are obtainable. These solutions appear to be very stable. When stored for some weeks in Jena glass flasks, they show no signs of settling. The increased conductivity observed after some months may be due to a solution of the glass or a gradual change in the colloidal particles. T. H. P.

324. Viscosity Theories of K. C. Sen, N. R. Dhar and Coworkers. P. C. van der Willigen. *Kolloid Zeits.* 46. *pp.* 55–57, *Sept.*, 1928.

Reference is made to an earlier paper [see Abstract 875 (1926)]. The term "viscosity," like other physical chemical terms, is considered of great importance because of their increased application in the biological sciences. The author considers that the influence of added electrolytes on the viscosity of colloids has so far not been correctly explained, because in the presence of large quantities of electrolytes other factors besides viscosity have been found to play a part, and because in the presence of small quantities of electrolytes so far there has been no indication of either a theoretical or an experimental relationship. J. K.

325. Pure Zinc. H. M. Cyr. *Am. Electrochem. Soc., Trans.* 52. *pp.* 349–353; *Disc.*, 353–354, 1927.

A comparison of commercial grades of zinc is made with the new product, "spectroscopically pure" zinc, which contains less than 0·0001 % of metallic impurities. "Spectroscopically pure" zinc is prepared by a series of fractional distillations of " chemically pure " zinc under vacuum until the product shows no impurity lines when examined spectrographically. This pure zinc exhibits unusual resistance to tarnishing and to the action of hydrochloric and sulphuric acids, but not to nitric acid. In dilute hydrochloric acid it lost 0·02 % by weight in the same time that a similar piece of commercial high-grade zinc entirely dissolved. Its slow rate of solution in these acids can be hastened by the use of a platinum couple. The physical properties of " spectroscopically pure " zinc are marked by unusual softness, a low recrystallisation temperature, which prevents strain hardening in cold rolling, a melting point of 419·45° C. and a tensile strength of 14,000 pounds per square inch (1000 kg. per sq. cm.). This metal is being produced in small quantities in the laboratory, and is being used in scientific investigations requiring metal of the highest purity. AUTHOR.

326. Mechanism of Crystal Growth by Annealing. T. Sutoki. *Tohoku Univ., Sci. Reports,* 17. *pp.* 857–876, *Aug.,* 1928. *In English. Report No.* 195 *from the Research Inst. for Iron, Steel and other Metals.*

Crystal growth of aluminium and tin containing 1·5 % of antimony was studied, the former being strained and the latter merely annealed. In the case of aluminium, a single crystal is able to grow at the expense of minute grains, but between single crystals of visible size no union is observable, no matter how long the annealing is continued. In the case of tin-antimony alloy, the concave side of the grains absorbs, in most cases, the adjacent convex grains, the curvature of the boundary gradually diminishing. A theory regarding the mechanism of crystal growth is proposed, in which the growth is interpreted as the force of attraction from the adjacent grain, acting on an atom in the boundary layer, and the effect of strain on the crystal growth is also explained. AUTHOR.

327. Preparation and Crystal Structure of Compounds of Palladium and Antimony. L. Thomassen. *Zeits. f. phys. Chem.* 135. 5–6. *pp.* 383–392, *Aug.,* 1928.

A method is described suitable for the preparation of alloys containing elements of widely different melting points. The preparation of the compounds PdSb and $PdSb_2$ is described and also their structure as determined by X-ray examination. PdSb has a nickel-arsenide structure with $a = 4·070$ Å.U., $c = 5·582$ Å.U.; $PdSb_2$ has a structure similar to iron pyrites with $a = 6·439$ Å.U. A. A. D.

328. Equilibrium Diagram of the Iron and Iron Sulphide System. K. Miyazaki. *Tohoku Univ., Sci. Reports,* 17. *pp.* 877–881, *Aug.,* 1928. *In English. Report No.* 196 *from the Research Inst. for Iron, Steel and other Metals.*

The diagram of the Fe–FeS system was redetermined by means of thermal analysis and the electrical resistance measurement. The iron sulphide used was prepared free from oxygen by the repeated melting of a Merck's sample with sulphur attended with subsequent solidification in a vacuum chamber. The thermal analysis was carefully conducted with the melt covered with a fused salt. AUTHOR.

329. Energising Action of Carbonates Contained in Carburising Mixtures. G. Takahashi. *Tohoku Univ., Sci. Reports,* 17. *pp.* 883–

926, *Aug.*, 1928. *In English. Report No.* 197 *from the Research Inst. for Iron, Steel and other Metals.*

It is a well-known fact that the velocity of carburisation in iron and steel is much accelerated by the use of a carburising agent which consists of a mixture of some carbonate and carbon, than in the case where carbon alone is used. The action has hitherto been considered to be due to the reduction of the carbonate with subsequent formation of carbon monoxide gas, which reacts upon iron and steel. This has been proved not to be correct, and it has been shown further that the carburisation is due to the action of the carbonate which sets free carbon from carbon monoxide, the nascent carbon atoms diffusing very easily into the iron and steel.

AUTHOR.

330. Corrosion of Iron. H. Endô. *Tohoku Univ., Sci. Reports,* 17. *pp.* 1111–1134, *Sept.*, 1928. *In English. Report No.* 204 *from the Research Inst. for Iron, Steel and other Metals.*

The present paper gives the results of experiments on the action of water, light, temperature, oxygen, acids and salt solutions, on the corrosion of iron, as well as on the mechanism of iron in passing into the passive state in solutions of $K_2Cr_2O_7$, K_2CrO_4, $KClO_3$ and $KMnO_4$. It forms the first report of the results of a long series of experiments, which are to be extended to various investigations of the corrosion of iron and other metals.

AUTHOR.

331. Equilibrium Diagram of the Copper-Tin System. T. Isihara. *Tohoku Univ., Sci. Reports,* 17. *pp.* 927–937, *Aug.*, 1928. *In English. Report No.* 198 *from the Research Inst. for Iron, Steel and other Metals.*

In the binary alloy of the copper-tin system, the solubility of tin in the α-solid solution is 14 % and the triple point (H) lies at 12 % of tin. The existence is denied of a field of a solid solution between the compound Cu_4Sn and $(\alpha + \delta)$, in a narrow range between 68 and 70 % of copper content. The intermetallic compound Cu_3Sn cannot exist in the liquid phase, and, as a consequence, the solidus and the liquidus lines do not coincide, but a freezing interval always exists between them. [See Abstract 958 (1925).]

AUTHOR.

332. Structure of Metals. H. J. Seemann. *Zeits. f. tech. Phys.* 9. 7. *pp.* 233–240, 1928.

This essay deals with the structure of alloys as determined by X-rays. It contains no new experimental results and deals only in a very general way with a few systems. Principally, it is devoted to the relation of the structure of an alloy to that of its components and also to the structure of inter-metallic compounds.

A. A. D.

333. Ludwig-Soret Effect in Metallic Alloys. M. Ballay. *Rev. de Mét.* 25. *pp.* 427–454, *Aug., and pp.* 509–520, *Sept.*, 1928.

Liquid alloys (*e.g.*, lead and tin), when held in a tube the ends of which are at different temperatures, tend to segregate, reaching equilibrium with a concentration varying from the cold to the hot end. For a given pair of metals the effect varies, depending whether the tube is vertical or horizontal. In a horizontal tube, without a central constriction, no change in concentration is found; but with a constriction, in general, definite changes of concentration ensue. The effect, however, is sometimes the reverse of that found when the tube is vertical. The paper contains a detailed description of the experimental methods adopted and the results obtained with molten alloys of copper-tin, tin-cadmium, tin-zinc, etc. The results are also given which are obtained using solid alloys of (*a*) lead and thallium, (*b*) platinum and rhodium. A theory of the effect is developed on a thermodynamic basis in which the variations of concentration are expressed in terms of heats of dilution and vapour tensions. The results from the alloys do not lend themselves to a verification of the theory owing to lack of data, but the results of Eilert on aqueous solutions are used and give at least approximate agreement. In any case the agreement is better than that given by the theory advanced by Van't Hoff to explain the effect. This latter theory, based on osmotic pressure, leads to the conclusion that for dilute solutions the concentrations should be inversely as the absolute temperatures, whilst the present theory shows that this ratio approaches unity for infinite dilution. A. A. D.

334. Phosphorescent Combustion of Sulphur. H. J. Emeléus. *Chem. Soc., J. pp.* 1942–1950, *July*, 1928.

Investigation of the nature of the reaction products indicates that the chemical change in the phosphorescent combustion of sulphur is the same as in the normal flame. No evidence of the formation of sulphur monoxide was obtained, although the conditions employed were such that, by analogy with the glow of phosphorus, lower oxidation products would have been produced if they existed. Negative results of tests for ozone show that, in this respect also, the chemiluminescent oxidations of sulphur and phosphorus differ.

The results of experiments on the inhibition of the phosphorescent glow by sulphur dioxide and by organic vapours emphasise the two distinct stages in the oxidation of sulphur, namely, the luminous and the non-luminous oxidation. The latter presumably takes place at the surface, but the slow luminous oxidation appears to be a gas reaction. T. H. P.

335. Initiation of Flame in Mixtures of Carbon Monoxide and Oxygen. W. E. Garner and A. S. Gomm. *Faraday Soc., Trans.* 24. *pp.* 470–473, *Sept.*, 1928.

The rate of reaction between mixtures of carbon monoxide and oxygen with and without infra-red radiation was measured. The reaction mixture was contained in a quartz vessel fitted at one end with a fluorite window, through which the infra-red radiations were admitted. The tube was maintained at a temperature of 750° C., and the infra-red radiations were obtained from a furnace at 1100° C. The reaction was followed by the pressure changes. No effect ascribable to the infra-red radiations was observed. F. J. B.

336. Chemical Reactions of Carbon Monoxide and Hydrogen after Collision with Electrons. A. Caress and E. K. Rideal. *Roy. Soc., Proc.* 120. *pp.* 370–385, *Sept.* 1, 1928.

The method previously described [see Abstract 3221 (1927)] has been extended to study the decomposition of carbon monoxide and its interactions with hydrogen. Its former reaction, which begins at 14 volts, shows a very marked acceleration when the energy of the bombarding electrons is raised to 19 volts; less distinct breaks were noted at 32 and 40 volts.

In equimolecular mixtures of carbon monoxide and hydrogen the action again began at 14 volts and showed a rapid rise at about 20 volts; the second rise in reaction-rate occurred at about 30 volts. The products in the first reaction are carbon, carbon dioxide and some carbon suboxide; in the latter reaction formaldehyde CH_2O is formed and then undergoes polymerisation. It is shown that hydrogen atoms formed by thermal dissociation interact with molecules of carbon monoxide and more readily with carbon monoxide positive ions; the latter will also interact with hydrogen molecules, but more readily if they are excited to the 2^2S level.
T. M. L.

337. Combustion. *Indust. and Engin. Chem.* 20. *pp.* 998–1057, *Oct.*, 1928. *Papers read before the Joint Symposium of the Divisions of Gas and Fuel Chemistry and Petroleum Chemistry of the Am. Chem. Soc.*, *Sept.*, 1928.

"Diffusion Flames," by **S. P. Burke** and **T. E Schumann:** "Measurement of the Temperatures of Stationary Flames," by **A. G. Loomis** and **G. S. J. Perrott;** "Radiant Energy from Flames," by **W. E. Garner;** "Bunsen Flames of Unusual Structure," by **F. A. Smith** and **S. F. Pickering;** "Flicker of Luminous Flames," by **D. S. Chamberlin** and **A. Rose;** "Flame Speed of Hydrogen Sulphide," by **D. S. Chamberlin** and **D. R. Clarke;** "Gaseous Explosive Reaction at Constant Pressure," by **F. W. Stevens;** "Normal Propagation of Flame in Gaseous Mixtures," by **W. Payman;** "Flame and Pressure Propagation," by **J. V. Hunn** and **G. G. Brown;** "Some Flame Characteristics of Motor Fuels," by **G. B. Maxwell** and **R. V. Wheeler;** "Importance of Mixture Ratio in Rating Fuels for Knock," by **J. M. Campbell, W. G. Lovell** and **T. A. Boyd;** "Action of Accelerators and Inhibitors upon the Oxidation of Liquid Hydrocarbons," by **T. E. Layng** and **M. A. Yonker;** "Partial Oxidation of Methane and Ethane in the Presence of Catalysts," by **T. E. Layng** and **R. Soukup** "Relative Rates of Reaction of Olefins in Combustion with Oxygen and in Oxidation with Aqueous Potassium Permanganate," by **H. S. Davis.**

338. Electronic Thermochemistry of Inorganic Compounds. Heat of Combination. A. Berkenheim. *Zeits. f. phys. Chem.* 136. 3–4. *pp.* 231–258, *Sept.*, 1928.

The atomic weight of any element in the periodic table is the arithmetic mean between the weights of its two neighbours. A similar rule is found to hold for the heat of combination, *e.g.*, of chlorides, oxides, etc. Thus Na, Mg, Al, are three consecutive elements of atomic weights 23, 24·3, 27·1; the heats of combination are: $NaCl = 97 \cdot 9$, $MgCl_2/2 = 75 \cdot 5$, $AlCl_3/3 = 53 \cdot 6$; the mean would be 75·7. The author shows that this rule applies generally and that it may be used to estimate undetermined heats of combination. Since the heat of combination is the sum of several components (heat of sublimation and of dissociation, equivalents of electronic affinity and of electrostatic attraction), the rule should be applicable to all these component terms. This is found to be so. Calculations are further made for Kossel's ideal atoms by assuming the atomic radii not to be all = 1, but to represent again arithmetic means; this is confirmed by the recent estimates of atomic structures deduced by various methods. A number of unknown heat values of ionic combinations are calculated on the strength of data of Kossel and of Goldschmidt. H. B.

339. Chemical Effect of Electrical Discharge in Ethane. S. C. Lind and G. Glockler. *Am. Electrochem. Soc., Trans.* 52. *pp.* 37–45; *Disc.*, 45–46, 1927.

In this paper the gaseous and liquid reaction products obtained from ethane under the influence of the silent electric discharge at 12,000 volts are described. A Siemens ozoniser was used in a closed system, the gases being pumped through the discharge region by an all-glass magnetic pump. From the analysis of the gaseous reaction products it appears that there exists a parallelism between the reaction produced by electric discharge and condensation caused by α-rays from radon. The empirical composition of the liquid products is: (1) From the analysis of the gas phase, $C_nH_{1\cdot 8n}$; (2) from the combustion of the liquid, $C_nH_{1\cdot 8n}$; Lind and Bardwell found by α-ray condensation that the empirical composition of their liquid product was $C_nH_{1\cdot 85n}$. [See also Abstract 2600 (1928).]

H. H. Ho.

340. Lead-Mercurous Iodide Voltaic Cell. W. C. Vosburgh. *Am. Chem. Soc., J.* 50. *pp.* 2386–2394, *Sept.*, 1928.

A series of cells, lead, cadmium and mercury, with potassium iodide or cadmium iodide, saturated with mercurous iodide as electrolyte, were set up, and the e.m.f. was measured at 25° C., and at 5° intervals between 20° and 40° C. The actual combinations were:—

$$\mathrm{Pb(Hg)/PbI_2 + \mathit{x}MKI//\mathit{x}MKI + PBI_2Hg_2I_2/Hg;}$$
$$\mathrm{Pb(Hg)/PbI_2 + CdI_2,\ sat.//CdI_2sat. + PbI_2 + Hg_2I_2/Hg;}$$
$$\mathrm{Cd(Hg)/CdI_2,\ sat.//CdI_2,\ sat. + Hg_2I_2/Hg.}$$

The e.m.f. of the first two was found to be $E_t = 0\cdot 31748 + 0\cdot 000129(t - 25)$ volt; the two cells agreed within the limits of reproducibility of the first, which was the less reproducible of the two. The third cell had an e.m.f. of $E_t = 0\cdot 41702 + 0\cdot 000360(t - 25)$ volt, which is in good agreement with the value obtained by Cohen, Bruins, and Yoshida. The free energy and entropy changes and the heat of reaction were calculated from these measurements.

F. J. B.

341. Capillary Electrical Phenomena of Amalgams. I. Thallium Amalgam. A. Frumkin and A. Gorodetzkaja. *Zeits. f. phys. Chem.* 136. 6. *pp.* 451–472, *Sept.*, 1928.

Electrocapillary curves of thallium amalgam are obtained for a series of solutions by the aid of a capillary-electrometer according to the method of Gouy. The curves are not identical with those of mercury; the maximum of the amalgam curves is strongly displaced in the direction of higher kathodic polarisation. The measurements are applied to the Gibbs theory of boundary surface phenomena, and the meaning of the displacement of the maximum is explained.

J. K.

342. Method of Potentiometric Analysis. B. Kamieński. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*a*. *pp.* 33–60, *Jan.–Feb.*, 1928. *In German.*

In oxidimetric titrations such as the reaction of ferrous, stannous, and ferrocyanide ions with permanganate solutions, a new method is devised for the electrometric indication of the end-point of the titration by means of the "sheltered electrode" principle. The solution is contained in a vessel fitted, as illustrated in Fig. 1, with a stirrer above which is mounted a curved tube containing electrodes of platinum wire near each of the ends, which are provided with suitable openings. The solution circulates through this tube at a regular speed, and, on account of the lag imposed on the circulation through frictional resistance, the composition of the solutions around the two electrodes has its maximum divergence when the end-point of the titration is reached. A pronounced difference of potential is then obtained which may be detected by a sensitive galvanometer or, better, by an accoustical method. This is applied by connecting with a valve amplifier as shown in Fig. 2 and interrupting the circuit so as to give an oscillation of audible frequency which may be used to operate a loud telephone. A mathematical treatment is given of the concentration relations by taking into account diffusion. J. N. P.

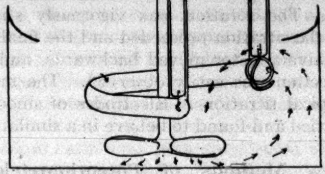


FIG. 1.

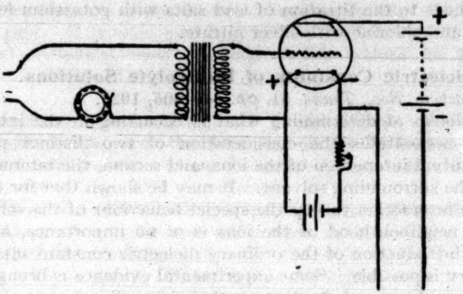


FIG. 2.

343. Use of Mercury as a Kathode in Electro-Analysis. H. S Lukens. *Am. Electrochem. Soc., Trans.* 52. *pp.* 309–314; *Disc.*, 314–315, 1927.

Conditions under which mercury kathode vessels suffer loss of mercury in electro-analysis are described. Limiting current densities to prevent such loss are determined. The reduction of nitric acid at a mercury kathode when cobalt is deposited is demonstrated. Certain other metals are shown to be free from such influence. The effect of oxygen on ether in the presence of light is discussed, and the action of the products produced on mercury is emphasised. The production in ether of a material or materials of explosive character with a boiling point at least as high as 120° C. is demonstrated. AUTHOR.

344. Application of a Pair of Monometallic Electrodes to Potentiometric Titration. E. Müller and H. Kogert. *Zeits. f. phys. Chem.* 136. 6. *pp.* 437–445, *Sept.*, 1928.

A method of electrometric titration in which two electrodes of the same metal were employed. Two platinum electrodes, one smooth and the other platinised, were placed in the solution and connected to a suitable galvanometer. The solution was vigorously stirred by a motor-driven stirrer. As the titration proceeded and the final point approached, the needle of the galvanometer moved backwards, and at the final point the maximum deflection was easily observed. The method was applied to a number of typical titrations. Electrodes of smooth and rhodinised rhodium were also tried and found to behave in a similar manner. F. J. B.

345. Two New Methods of Potentiometric Titration. E. Müller and H. Kogert. *Zeits. f. phys. Chem.* 136. 6. *pp.* 446–450, *Sept.*, 1928.

Two methods of electrometric titration are described. The basis of the methods is the employment of two electrodes of the same metal, and the variation of the e.m.f. between them as the reaction takes place between the titrated liquid and the drop of the titration solution. A form of apparatus suitable for each method is described, and the applicability of the methods to the titration of lead salts with potassium ferrocyanide, and iodine and chlorine with silver nitrate. F. J. B.

346. Dielectric Constants of Electrolyte Solutions. P. Debye. *Am. Electrochem. Soc., Trans.* 51. *pp.* 449–505, 1927.

The problem of determining what is occurring in the interior of an electrolyte necessitates the consideration of two distinct phenomena: first, the mutual interaction of the ions, and second, the interaction of the ions with the surrounding solvent. It may be shown that for the limiting laws in the interaction theory the special behaviour of the solvent in the immediate neighbourhood of the ions is of no importance, and for this reason the introduction of the ordinary dielectric constant into the interaction theory is possible. Some experimental evidence is brought forward to show the influence of the ions on their immediate surroundings. The problem is treated from an electrical point of view, and experimental evidence is brought forward in support of the theory. F. J. B.

347. Recent Advances in the Ionisation Theory as Applied to Strong Electrolytes. V. K. LaMer. *Am. Electrochem. Soc., Trans.* 51. *pp.* 507–555; *Disc.*, 556–558, 1927.

The anomaly of strong electrolytes is reviewed from the standpoint of incomplete dissociation and from the modern point of view of practically complete dissociation and inter-ionic attractions, for which purpose the activity concept was developed. It is shown that the theory of Debye and Hückel suffices as an explanation of the observations in dilute solutions. The theory is presented in detail, a survey of the experimental data designed to test the theory, some of which is new, is given. A conversion table relating the values for the ion size obtained for the first approximation and the complete solution for the symmetrical valence types is given. Brönsted's principle of specific interaction is discussed, also the question of the meaning on the true degree of dissociation of strong electrolytes. F. J. B.

348. Electrochemistry of Solutions of Mixed Electrolytes. H. S. Harned. *Am. Electrochem. Soc., Trans.* 51. *pp.* 571–604; *Disc.,* 604, 1927.

The solubility and electromotive force methods for determining the activity coefficients of an electrolyte in a solution of another electrolyte are outlined. The law of the linear variation of the logarithm of the activity coefficients is discussed from a number of points of view. The activity coefficients of strong acids and bases in salt solutions are contrasted. A method is outlined for the determination of the ionic activity coefficient product and dissociation of water in salt solutions. Liquid junction potentials and individual ion activity coefficients are defined and discussed.

The halide and alkali metal ions, with their highly symmetrical and not easily deformable electron shells, exhibit normal behaviour, such as the approximate additivity of their partial free energies. With those which are more easily deformable in the high electrical fields of ionic solutions, a departure in behaviour from the normal is found, and the more unsymmetrical the ion becomes, the greater the departure. Thus, the hydroxyl ion, which is most unsymmetrical, is most easily changed by the electrical field of other ions, and is, therefore, the most abnormal of the ions here considered. It is found that the kind of ion which is based upon its fine structure more than its diameter will determine its reactivity with ions of opposite sign. If its structure is unsymmetrical enough, it may form undissociated molecules with nonpolar bonds instead of association complexes. J. N. P.

349. Electrical Conductivity of Hydrochloric, Hydrobromic and Hydriodic Acids, and the Mobility of the Hydrogen Ion. M. Hłasko and D. Ważewski. *Acad. Polonaise Sci. et Lettres, Bull.* 4–5*a. pp.* 181–190, *April–May,* 1928. *In French.*

The limiting conductivities of aqueous solutions of HCl, HBr, and HI were determined. The acids and water were most carefully purified in quartz vessels. The limiting values for the acids were: HCl = 431·5, HBr = 433·7, HI = 432·3. These values are higher than the generally accepted values, and the mobility of the hydrogen ion was also found to be higher than the value usually accepted, *viz.,* 355·1. The viscosities and the densities of the solutions were also determined. F. J. B.

350. Dispersion of Conductivity of Strong Electrolytes. P. Debye and H. Falkenhagen. *Zeits. f. Elektrochem.* 34. *pp.* 562–565, *Sept.,* 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May,* 1928.

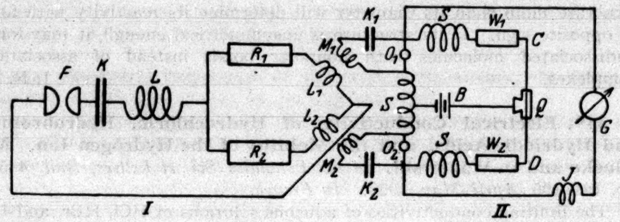
The general theory of dispersion phenomena has been formerly developed from a consideration of the Brownian movements and the time of relaxation of the ionic atmospheres and by taking into account the influence of concentration, mobility of ions, temperature, dielectric constant and valency. An account is at present given of measurements made on the conductivity of a cadmium sulphate solution of concentration 0·001 m. as a function of the wave-length or frequency of the current. It is calculated that electrophoretic action causes a fall of 5·6 % of the conductivity value at infinite dilution, and the relaxation effect a further fall of 5·7 % of the limiting value when the frequency of current is zero, *i.e.,* direct current. With diminishing wave-length the electrophoretic action is unchanged, but the relaxation effect falls, and is reduced to about one-half at a wave-length of $\lambda = 6 \cdot 5$ m. These results are in accordance with the general theory. [See Abstract 2817 (1928).]

J. N. P.

351. Influence of Time of Relaxation of Ionic Clouds in Conductivity of Electrolytes. H. Falkenhagen and J. W. Williams. *Zeits. f. phys. Chem.* 137. 5–6. *pp.* 399–420, *Oct.*, 1928.

The influence of the factor known as the relaxation time of the ionic atmosphere is discussed in relation to its bearing on the dependence of conductivity on the frequency of the alternating field, or the so-called dispersion effect, and also on its dependence on the field strength, particularly with high fields, or the Wien effect. In measurements made with a number of salt solutions, the results are plotted showing the effect of concentration, temperature and valency on the influence of wave-length on conductivity. The influence of all these factors and also of the dielectric constant on the dispersion is found to agree with the values deduced theoretically.

The Wien effect is tested by employing an oscillating circuit as shown at I in the Fig., with condenser K and spark-gap F, whereby voltages up to 500,000 can be applied. The electrolyte under measurement is connected at R_1 and a comparison liquid resistance at R. If any difference occurs between the two resistances a current is produced in the oscillating coupled circuit II and actuates the galvanometer G. Further data are given which show that with increasing strength of field, the conductivity of a salt solution approaches the limiting value for infinite dilution and the conductivities for given field strengths are found to be in agreement with calculated values.



J. N. P.

352. Passivity of Metals. W. J. Müller. *Zeits. f. Elektrochem.* 34. *pp.* 571–586, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May,* 1928.

The theory of film formation previously put forward to account for polarisation is further developed. The change of current density with time during the passivation of metals establishes the relation that the polarisation of the metal during the coating is equivalent to the value for the active metal in contact with the corresponding saturated metal salt solution. If "chemical passivity" occurs, the curve representing the change of current density with time deviates from the curve of film polarisation. Extended measurements of the potential-current density relation with time with iron electrodes in ferrous sulphate and sulphuric acid solutions of different concentrations have established the following relation to exist between time of passivity and initial current density:

$$\log t = \log A - n \log \frac{i_0}{F_0},$$

where n is an exponential coefficient, A a constant representing the passifying power of the electrolyte, i_0 the initial current density and F_0 the initial free surface. The effect of convection is found to prolong the time necessary for passivation on account of the loss of ions from the bounding surface, and its influence is smaller at high current densities. The oxide films on iron observed by Evans are found to have no influence on passivation in acid solutions. In the activation of a passive film on iron, the separation of copper is found by oscillograms to occur in less than 1/30 second. In a theoretical survey of the subject, a complete representation of passivity is developed on the basis of the observed phenomena. [See also Abstract 1103 (1928).] J. N. P.

353. Cataphoresis in Copper Oxide Sols. Application of Debye and Hückel's Theory of Electrolytic Conduction to Colloid Particles. H. H. Paine. *Faraday Soc., Trans.* 24. 8. *pp.* 412–429, *Aug.*, 1928.

A simple apparatus is described for measuring the mobilities of the particles of very pure colloidal solutions of copper oxide by the transportation method, the amount of colloid transported being determined by volumetric analysis. The highest mobility observed of the copper oxide particles was $52 \cdot 8 . 10^{-5}$ cm. per sec. per volt per cm. for a colloidal solution of specific conductivity $0 \cdot 46 . 10^{-6}$ ohm^{-1} cm.$^{-1}$. Extrapolation indicates the mobility about $60 . 10^{-5}$ cm. per sec. for sols of zero conductivity. Analysis of the results of experiments on the diminution of mobility caused by addition of electrolyte and of those of Freundlich and Zeh (*Zeits. f. phys. Chem.* 114. *p.* 65, 1924) shows that the decrease in mobility from the value at zero electrolyte concentration is directly proportional to the square root of the concentration of the electrolyte. Application of Debye and Hückel's theory to colloidal solutions is discussed, and indications are given of the effect of the size of the central particle on the diminution of mobility produced by electrolytes. Suggestions are made concerning the bearing of this effect and of the above square root rule on the relation between the colloidal and ionic states [see Müller, *Koll. Beihefte*, 26. *p.* 257, *April*, 1928]. T. H. P.

354. Influence of the Solvent on the Mobility of Electrolytic Ions. R. T. Lattey. *Phil. Mag.* 6. *pp.* 258–270, *Aug.*, 1928.

The evidence in favour of the application of Stokes' law to the motion of an ion in a liquid electrolyte is first reviewed. An examination of the data shows, however, that in the majority of cases $\lambda\eta$ only approximates to constancy in solvents whose dielectric constant is low, but that it can be expressed with remarkable accuracy by the equation $\lambda\eta = \alpha + \beta(\theta D)^2$, where λ is the mobility, η the viscosity of the solvent, α and β constants characteristic of the ion, θ the temperature and D the dielectric constant. Tables are included giving value for various salts in water at temperatures between 0° C. and 156° C. and also in methyl and ethly alcohols; and for sodium iodide, tetra-ethyl-ammonium iodide and tetra-ethyl-ammonium picrate in a number of organic solvents. H. H. Ho.

355. Theory of Mobilities of Hydrogen and Hydroxyl Ions. E. Hückel. *Zeits. f. Elektrochem.* 34. *pp.* 546–562,; *Disc., p.* 562, *Sept.*, 1928. *Paper read before the Deut. Bunsen Gesell., Munich, May*, 1928.

It is found that at temperatures up to 480° C., the relative differences in the mobilities of the ions H′ and OH′ and those of other ions increase with increasing temperature. On the basis of Ohm's law, the frictional forces on the ions are considered, and from Stokes' law, calculations are made of the ionic radii. The view is adopted that hydrogen ions or protons occur in a liquid in combination with water molecules to form the hydroxonium ion, $H_3\dot{O}$. The apparent radii of these ions are, however, greater than the calculated values. The discrepancy is explained by the view that conductance is brought about, apart from the actual migration of the bipole, by a transference of the proton from one water molecule to an adjacent one. On account of the unsymmetrical structure of the $H_3\dot{O}$ group, it is assumed that an oscillation of this bipole occurs until the proton is in a favourable position relative to the adjacent water molecule to facilitate its transfer. An analogous interchange is postulated to occur between a hydroxyl ion and the neighbouring water molecule, whereby the hydroxyl ion is transformed into a water molecule leaving the adjacent water molecule as a hydroxyl ion. Conductance is thus brought about by a mechanism somewhat similar to the original representation of Grotthus. The theory is supported by detailed calculations made of migration velocities and the influence of temperature by employing probability considerations and the Maxwell-Boltzmann distribution relation, the turning moment of the bipoles, the period of relaxation and the dielectric constants. Speculations are put forward to account for anomalous ionic mobilities in non-aqueous solutions. J. N. P.

356. Diffusion of a Hydrogen or Reducing Potential through Platinum and Palladium. P. Köhler. *Zeits. f. phys. Chem.* 135. 5–6. *pp.* 369–382, *Aug.*, 1928.

The work of Nernst-Lessing and Schmid-Lücke on hydrogen diffusion through platinum is investigated further and confirmed. It is shown that for other reducing agents the diffusion through palladium becomes less the more the potential in respect to a hydrogen electrode approaches the oxygen side. The effect of the thickness of the platinum and palladium crucibles is investigated as well as the square root rule. J. K.

357. Effect of Hydrogen Ion Concentration on Overpotential. F. P. Bowden. *Faraday Soc., Trans.* 24. *pp.* 473–486, *Sept.*, 1928.

The decomposition of hydrogen peroxide, in presence and in absence of sodium hydroxide, has been investigated in glass, wax, and silica vessels. The catalytic activity of the surface of the containing vessel and of the dust content of the solution, in each case, has been calculated, the order of magnitude being always silica > glass > wax (dust). The rate of decomposition decreases with increasing (initial) concentration of hydrogen peroxide, but increases with increasing sodium hydroxide concentration. The critical increment increases with increasing initial concentration of hydrogen peroxide and decreases with increasing sodium hydroxide. The influence of small quantities of ferric hydroxide—such as might be present in caustic soda solutions—was found negligible, justifying the positive catalytic effect attributed to the hydroxyl ion.

H. H. Ho.

358. Overpotential at Metallic Kathodes: Cadmium and Antimony in Neutral and Alkaline Solutions. J. Grant. *Faraday Soc., Trans.* 24. *pp.* 367–370, *July*, 1928.

The variations of overvoltage for these kathodes with time, current density, and the duration of the interval of the commutator, are of the same nature as those observed with silver [see Abstract 1771 (1928)], the relation between overpotential and p_H being linear. With silver, deviations were found, especially with solutions containing NH_3 and HCO_3 ions, possibly owing to the readiness with which these solutions yield gas. Moreover, in neutral solutions effective buffering is lacking. T. H. P.

359. Electrical Deposition of Rubber. S. E. Sheppard. *Am. Electrochem. Soc., Trans.* 52. *pp.* 47–81; *Disc.*, 81–82, 1927.

In this paper is considered the theoretical electrochemistry of a rapidly developing art. It is shown that electrophoresis and electroosmosis are inversely proportional to the actual conductivity of the solution. It is stated that anodically attackable electrodes are best for rubber deposition and that zinc anodes have been found most useful. A table showing the electric migration velocities of various suspensions in water makes it clear why compounding ingredients added to latex can be electrodeposited with the rubber uniformly and substantially in the proportions in the mix. The view of McBain and Bowden as to the substantial identity in the processes involved in the transport of matter electrically in solutions, in colloids, in emulsions and suspensions, is referred to and developed. J. K.

360. Electrolytic Preparation of Para-Aminophenol. D. Caeser. *Am. Electrochem. Soc., Trans.* 52. *pp.* 95–106; *Disc.*, 107, 1927.

A comparison of the electrolytic with the chemical processes for the production of para-aminophenol indicates several advantages which might accrue to the electrolytic process as a commercial method. The author, investigated the choice of proper electrodes and current density for the electrolytic cell. Copper gauze as the kathode, duriron as the anode, and a current density of four to five amperes per square decimetre gave the best yields. Other factors influencing the electrolysis are: nature of diaphragm, composition of katholyte and anolyte, temperature of reduction, and catalysts employed. The author indicates possibilities of development along other lines. AUTHOR.

361. Laboratory Hydrogen-Oxygen Generator. C. G. Fink and C. L. Mantell. *Am. Electrochem. Soc., Trans.* 52. *pp.* 109–113; *Disc.*, 113–114, 1927.

For experimental investigations with hydrogen gas the use of compressed gas in steel cylinders is objected to, on account of the difficulty of maintaining a constant supply at constant pressure over long periods of time. On the other hand, the installation of standard electrolytic cells involves considerable expense. Accordingly, the authors describe a simple glass cell, using nickel electrodes in a 30 % NaOH solution. At 15 amperes, 5·66 litres per hour of hydrogen were produced. AUTHORS.

362. Potential of Aluminium in Aqueous Solutions. L. Kahlenberg and S. J. French. *Am. Electrochem. Soc., Trans.* 52. *pp.* 355–360; *Disc.*, 361–362, 1927.

The potentials of pure aluminium and commercial aluminium have been measured in aqueous solutions of KCl. Pure aluminium develops a slightly higher voltage. Oxygen depresses the voltage, which can be raised again by displacing the oxygen by nitrogen, hydrogen, illuminating gas, or carbon dioxide. The voltage can thus alternately be raised or lowered at will, showing that an oxide film is not the cause of the low voltage in oxygen, but that the low values are caused by oxygen adsorbed by the surface of the metal. Amalgamating the surface raises the voltage materially, and also greatly increases the corrosion. AUTHORS.

363. Transference Numbers and Activities of Sodium Hydroxide in Aqueous Solution. A. L. Ferguson and A. W. Schluchter. *Am. Electrochem. Soc., Trans.* 52. *pp.* 363–373, 1927.

The concentration cell method has been applied to the determination of the transference numbers of sodium hydroxide. The values recorded in the literature for the transference numbers of sodium hydroxide are unsatisfactory. At the same time the activity coefficients were determined up to nearly normal concentration. The results show that the transport numbers change with concentration. Nc decreases from 0·203 at the concentration 0·01004 to 0·153 at the concentration 2·825. The activity coefficients change from 0·920 at the concentration 0·01004 through a minimum of 0·707 at the concentration 0·9738, then increase to 0·842 at the concentration 2·825. AUTHORS.

364. Principles of Electrolytic Studies on Corrosion. W. Blum and H. S. Rawdon. *Am. Electrochem. Soc., Trans.* 52. *pp.* 403–429; *Disc.*, 429–433, 1927.

The authors review in detail former work on corrosion as seen from the electrolytic standpoint and take exception to the corrosion test proposed by Anderson and Enos, which depends upon the loss in weight produced in a given period when a definite current is passed through a cell in which the metal specimen is the anode. Their tests indicate not even an approximate correspondence between losses in weight obtained by this method and that obtained when the same metals are subjected to simple immersion in the same solutions. Following a suggestion of Bancroft, the authors investigated whether a relationship existed between corrosion resistance and the potential required to produce a certain current density, or loss in weight. The results can be plotted in the form of current density-potential curves, or loss in weight-potential curves, or penetration-potential curves. The results indicate that this method may form a possible basis of an accelerated electrolytic corrosion test. J. K.